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VOL. 41. Ser. A. Part 11. pp. 337–388. NOVEMBER, 1953.

THE REVIEW OF APPLIED ENTOMOLOGY

SERIES A: AGRICULTURAL.

ISSUED BY THE COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

LONDON:
COMMONWEALTH INSTITUTE OF ENTOMOLOGY,
41, QUEEN'S GATE, S.W.7.

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Tomaszewski (W.) & Gruner (H. E.). **Die Temperaturabhängigkeit der Wirkung synthetischer Insektizide (DDT, Hexa) auf den Kornkäfer (*Calandra granaria* L.).** [The Dependence on Temperature of the Effect of synthetic Insecticides (DDT, BHC) on *C. granaria*.]—*Beitr. Ent.* **1** no. 2 pp. 105–109, 2 graphs, 19 refs. Berlin, 1951.

During tests with DDT against *Calandra granaria* (L.) in stored grain in Germany in 1944, it was observed that treatment was considerably less effective in midsummer than in spring, and the effect of temperature on the toxicity of proprietary dusts containing DDT or BHC and a 1 : 10 mixture of both to the weevil was investigated in the laboratory. The insects were reared at 23°C. [73·4°F.], and adults 10–25 days old were kept for a fortnight at 15, 23 or 30°C. [59, 73·4 or 86°F.] in treated rye under suitable conditions of humidity. The effectiveness of DDT and to a less extent that of the mixed dust decreased [*cf. R.A.E.*, A **39** 53] and that of BHC increased with rising temperatures. The insecticides were applied to the grain at very low rates, and when larvae up to a week old were present, BHC was the only one to give any mortality of them. At normal rates of application, the adverse effects of high temperature on the toxicity of DDT were negligible.

Nolte (H. W.). **Beiträge zur Morphologie und Biologie des Lärchenblasenfusses (*Taeniothrips laricivorus* Krat.).** [Contributions to the Morphology and Biology of *T. laricivorus*.]—*Beitr. Ent.* **1** no. 2 pp. 110–139, 12 figs., 22 refs. Berlin, 1951.

The author describes all stages of *Taeniothrips laricivorus* Krat. & Farský, reviews its distribution, and gives an account of observations in 1944 on its bionomics on larch at Tharandt, in Saxony, near the Czechoslovak border [*cf. R.A.E.*, A **31** 28]. There were two generations a year, and total development from egg to adult lasted 36–56 days for the first and 22–33 days for the second. Pupation took place in crevices in the bark of the trunk or sometimes in the litter beneath the trees, and the adults emerged in the first half of July and the second half of August. It was not known how many eggs were laid, but the number of living offspring averaged 42 per female. The ratio of males to females was 2 : 3. The injury [*cf. loc. cit.*] is usually not serious, but leads to infection by various fungi and sometimes to the suppression of infested trees in mixed stands. The chief natural enemies observed were *Aeolothrips vittatus* Hal. and the Anthocorid, *Tetraphleps vittatus* (Fieb.) (*bicuspis* (H.-S., 1850)).

Schwenke (W.). **Untersuchungen zum Massenwechsel der Kiefernspanner *Bupalus piniarius* L. und *Semiothisa liturata* Cl. auf vergleichend-biozönotischer Grundlage.** [Investigations on the Fluctuation in Numbers of *B. piniarius* and *S. liturata* on a comparative biocoenotic Basis.]—*Beitr. Ent.* **2** no. 1 pp. 1–55, 12 figs., 25 refs. Berlin, 1952.

A major obstacle to the study of the causes of outbreaks of forest insects is that population densities are so low in the early stages that statistical analysis, based on absolute values, is impossible. The author considers that this difficulty can be obviated by comparative environmental studies of fluctuations in numbers, and gives the results of an investigation on the factors governing the local distribution of normal populations of overwintering pupae of *Bupalus piniarius* (L.) and *Semiothisa liturata* (Cl.) in pine forests to the south-east of Berlin in 1950–52. Since the variations

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were to be considered solely in relation to environment, it was immaterial whether infestation was heavy or light.

The forests are described, and it is demonstrated on a basis of ground flora and moisture conditions, as shown by the presence of certain indicator plants and the vigour of the trees, that environments or biocoenotic forest types of five main orders were present. Pupae were collected from sample rectangles each covering almost six square yards about the trunks of sample trees, and the results are analysed and discussed for each of these environments. Those for *S. liturata* concern pupae of two generations that were inseparable [*cf. R.A.E.*, A **30** 245]. The pupae of both species were found almost exclusively beneath the crowns of the trees and were more numerous under moss than under litter, except when the moss was overgrown with *Calluna* or *Vaccinium*. Pupae were more numerous and their distribution was more uniform in the centre of a stand than at the edges, and this was largely due to the protection from the wind afforded to the ovipositing adults. The relation between the number of pupae per unit area and the age of the stand varied with the environment, so that the three factors were inseparable. *B. piniarius* increased its numbers in all environments during the two years, but the numbers of *S. liturata* rose in some and fell in others. In similar environments, pupae were more numerous in the west of the district investigated than in the east, and rainfall in 1949 and 1950 also diminished from west to east.

It is concluded that the results of pupal counts are highly comparable, provided that they are obtained from stands of the same age in similar environments and that the sampling areas chosen for investigation proportionately reflect the composition of the whole stand.

Blunck (H.). **Zur Kenntnis der Hyperparasiten von** *Pieris brassicae* **L. 6. Beitrag:** *Gelis corruptor* **Först. und** *Gelis faunus* **Först.** [Contributions to the Knowledge of the Hyperparasites of *P. brassicae*. Sixth Contribution: *G. corruptor* and *G. faunus*.]—*Beitr. Ent.* **2** no. 1 pp. 94–109, 3 figs., 14 refs. Berlin, 1952.

Over a third of the Ichneumonids of the genus *Gelis* reared from field-collected cocoons of *Apanteles glomeratus* (L.), a parasite of *Pieris brassicae* (L.), in Germany in 1930–50 [*cf. R.A.E.*, A **41** 249, etc.] were identified as *G. corruptor* (Först.), of which *G. faunus* (Först.) is considered to be a synonym or variety. The morphology of the adult males, of which apterous and alate forms occur, and of the females, which are all apterous, is described, the synonymy of the species is discussed, and its distribution throughout Europe is reviewed from the literature. It emerged from host material collected in Schleswig-Holstein, Bavaria, Saxony and the district of Berlin, and was reared in the laboratory on *Apanteles*. Its bionomics differed little from those of other species of *Gelis* [*cf.* **41** 133]. The males were more active than the females and were less numerous than females in the field-collected material but predominated among adults reared in the laboratory, unfertilised females producing male progeny only. Pairing was not observed, but females were repeatedly seen probing cocoons of *A. glomeratus* with the ovipositor. Total development lasted 21–22 days at room temperatures averaging 17°C. [62·6°F.] and 4–5 weeks when the temperature was allowed to drop to −7°C. [19·4°F.] on four days. Females kept in the laboratory at room temperatures survived for about three months. The larvae are believed to overwinter in the host cocoon, and there is certainly more than one generation a year in the field. Although by no means rare, *G. corruptor* constituted only about 0·5 per cent. of all the Ichneumonids obtained.

Härdtl (H.). **Der Wechsel der Erdfloharten bei Sommerraps.** [The Succession of Species of Flea-beetles on Summer Rape.]—*Beitr. Ent.* **2** no. 1 pp. 109–113, 6 refs. Berlin, 1952.

Rape and turnip rape are frequently damaged in spring by *Phyllotreta* spp., the overwintered adults of which attack the germinating shoots before they appear through the soil. *P. atra* (F.) constituted about 94 per cent. of the flea-beetles found on winter rape in the summer of 1942, and *P. nigripes* (F.) about 4 per cent. In investigations in 1942–43 on the constitution of the spring population on summer rape, flea-beetles were collected on sample plots near Pulawy, in central Poland, each afternoon when the plants were in the cotyledonary stage, and again after the first pairs of true leaves were formed. The severity of injury was also assessed. The species taken were *P. atra*, *P. undulata* Kutsch., *P. nemorum* (L.), *P. vittula* (Redt.), *P. nigripes* and *P. striolata* (F.) (*vittata* (F.)). The first three were the commonest in both years, but as the summer advanced, the proportion of *P. atra* increased as some of the other species migrated to different food-plants. In 1942, the average number of beetles per unit area of leaf surface decreased slightly during both periods, the percentage of plants attacked fell slightly in the first but not in the second, and the number of plants with half their leaf surface injured dropped considerably in both. There was no apparent relation between the numbers of flea-beetles present and the severity of the injury. Late-sown crops were less injured than those sown early, but gave poorer yields, so that chemical control on the earlier sowings appears advisable.

Schwerdtfeger (F.). **Neue Untersuchungen über die Wirkung von Hexamitteln zur Engerlingsbekämpfung.** [New Experiments on the Effectiveness of BHC Preparations for controlling Cockchafer Larvae.] —*Z. PflKrankh.* **57** pt. 9–10 pp. 344–350, 5 graphs, 1 ref. Ludwigsburg, 1950.

Since experiments in 1948–49 showed that technical BHC is effective against larvae of *Melolontha* in forest nurseries but sometimes injures the plants [*cf. R.A.E.*, A **41** 289–290], laboratory tests were carried out in Germany in 1950 to study the effect on first-instar larvae of *M. hippocastani* F. and the phytotoxicity of commercial preparations containing the technical product or pure γ BHC. As the preparations contained different proportions of active ingredient, the rates of application are given as γ BHC per 100 sq. yards.

In tests of toxicity, larvae were placed in pots filled with soil treated with dry preparations at rates equivalent to 0·15–2·4 oz. The soil was covered with turf, the pots watered regularly, and the larvae counted each week for seven weeks. Toxicity was slightly but consistently higher for pure γ BHC than for technical BHC, though the difference was probably not significant. Effectiveness in preventing feeding was estimated by weighing the larvae each week, and this showed that pure γ BHC was ineffective at 0·15 oz., but that technical BHC at the same rate and both materials at the higher ones caused reductions in weight, technical BHC being the more effective in each case. In tests of repellence, cylinders containing two 5-in. layers of soil, the lower untreated and the upper one treated with technical BHC or pure γ BHC at 0·3 or 1·2 oz., were used. Field-collected larvae were introduced into the base of the cylinders in spring, when migration towards the soil surface was beginning, and their vertical movements were observed. The larvae tended not to enter soil treated with technical BHC, and gathered at the top of the untreated soil, but pure γ BHC was not repellent, and

the larvae entered the soil treated with it as readily as untreated soil in the controls.

Phytotoxicity was tested by planting larch seedlings in pots containing soil treated at 0·3–4·8 oz. and measuring their height and weight after six months. No differences were observed between the rates for a given material, but trees in soil containing technical BHC were somewhat smaller than the controls and their increase in weight was also less, whereas there was no reduction in height increase for pure γ BHC and only very slightly less increase in weight.

In investigations of the extent to which water carried the insecticide into the soil, an emulsified solution and a suspension of γ BHC were applied at 2·4 oz. to moist soil that had been firmly pressed into cylinders 10 ins. high, the amount of liquid being 15 pints per sq. yard of surface. After 24 hours, the soil was removed in layers of 1·2 ins. and first-instar larvae exposed to it. The insecticidal effect was good in both cases in the two upper layers but slight at greater depths. To discover whether heavy rain would carry the insecticide deeper, soil treated as in the previous experiment or having a dry preparation mixed at the same rate with the upper 1·2-in. layer was exposed in cylinders for 18 days to natural rainfall and also frequently watered, the total being equivalent to 12 ins. rain. When the soil was tested as before, the results were unaltered for the emulsified solution and suspension, though distribution in the upper two layers was slightly improved, and it was evident that the dry preparation had scarcely penetrated at all beyond the layer with which it had been mixed.

RÖNNEBECK (W.). **Über die Frühjahrsentwicklung der Grünen Pfirsichblattlaus (*Myzodes persicae* Sulzer) am Primärwirt im Hinblick auf ihre Bedeutung als Virusüberträger im Kartoffelfeld.** [On the Spring Development of *Myzus persicae* on its primary Host with Respect to its Significance as a Virus Vector in Potato Fields.]—*Z. PflKrankh.* **57** pt. 9–10 pp. 351–357, 3 graphs, 6 refs. Ludwigsburg, 1950.

Since the spread of virus diseases in potato crops by *Myzus* (*Myzodes*) *persicae* (Sulz.) begins with the arrival of the spring migrants from peach, the development of the spring infestation on the latter and the dates of migration from it were investigated near Bonn in 1947–50.

The first fundatrices hatched about 10th February in normal years. When twigs bearing winter eggs were kept in water in an unheated greenhouse open to the weather on two sides, only about 55 per cent. of the eggs hatched. The first fundatrix became adult before hatching was complete in the greenhouse, but not until 12–16 days after in the field. Eggs on twigs removed in mid-December to a heated greenhouse did not hatch. Mortality of the fundatrices in the first two instars was generally higher in the field than was likely to be caused by weather alone and reached 50 per cent. in an exposed site in 1948.

For observations on the succession of generations, immature fundatrices and fundatrigeniae were isolated in gauze cages on peach trees in 1949 and 1950. In both years, the first and second generations of fundatrigeniae included apterae, but the third consisted entirely of alates. Further generations of apterae were reared in greenhouse cultures, but the work was discontinued in the fifth generation when it was discovered that under these conditions the progeny of the alate migrants could also develop on peach. Nymphs were produced by alates in cages on peach in the field, but they all died at the latest in the third instar. Small numbers of first-generation fundatrigeniae from two sources at higher altitudes on the right bank of the Rhine were caged in the field near Bonn in mid-May, and their offspring all

developed into alates, so that third-generation fundatrigeniae are probably rare or absent at higher altitudes. Both field and greenhouse observations showed that fundatrices give rise directly to alates towards the end of their reproductive period, and these become adult 4–7 days before the alate offspring of the apterous fundatrigeniae. The alates left the peach trees chiefly in May, and spraying to control the Aphids on potato should be begun at that time. Only a few early potatoes were then in leaf at the higher altitudes, and the main-crop and late varieties became infested about four weeks later, when the first alates had been produced on the summer food-plants.

The sprays of 6 per cent. tar distillate (fruit-tree carbolineum) recommended for control of the winter eggs on peach sometimes injure the buds, and tests were made in late January 1950 with sprays of two proprietary preparations of DNC with tar distillate or mineral oil, which are applied at lower concentrations. They reduced the percentage of eggs that hatched from 55 for no treatment to 1 and 0, respectively, and the numbers of colonies of the Aphid on 21–25 trees in May from 356 to 6 and 1, and caused no plant injury. The spray of DNC and oil is also effective against winter eggs of *Paratetranychus pilosus* (C. & F.).

Melis (A.). **Precisazioni morfo-biologiche sull'** *Aspidiotus perniciosus* **Comst.** [Notes on the Morphology and Biology of *Quadraspidiotus perniciosus*.]—*Redia* **36** (1951) pp. 1–91, 8 pls., 13 figs., 14 refs. Florence [1952].

The author supplements his earlier paper on the bionomics of *Quadraspidiotus* (*Aspidiotus*) *perniciosus* (Comst.) in Italy [*R.A.E.*, A **36** 64] with information obtained in 1943–50. It was found that the immature Coccids continued their development during the winter, though at a much reduced rate, the majority being in the first instar during the first half of winter and in the second in the second half. A few adult females also overwintered. Development was resumed at the normal rate in mid-March [*cf.* **37** 457], and the adult males appeared up to 20 days before the females. The proportion of the sexes varied considerably in the various generations, females generally being more numerous than males in the overwintering population. The emergence of the crawlers from the parent female is described. As many as 17 were found under individual scales, and females produced an average of 120 crawlers each. Although *Q. perniciosus* produced five generations a year when first introduced into Italy [**36** 64], only three and an occasional fourth have been observed in central and northern districts since it became acclimatised there. Tests to determine whether fruits would become infested when placed in close proximity to infested material showed that the crawlers could not cross the least obstacle [**36** 64] and were unable to migrate for more than about 1·5 ins. In view of this, the author concludes that restriction of international trade in fruit from infested countries is not warranted [**39** 71].

Martelli (M.). **I trattamenti contro l'***Hoplocampa brevis* **Klug (Hymenoptera Tenthredinidae) in rapporto al ciclo evolutivo dell'insetto.** [Treatments against *H. brevis* in Relation to its Life-cycle.]—*Redia* **36** (1951) pp. 93–110, 3 figs., 11 refs. Florence [1952].

Observations on the bionomics of *Hoplocampa brevis* (Klug) on pear are briefly described, and an account is given of experiments on its control near Florence, Tuscany, in 1948 and near Parma, Emilia, in 1949 and 1950, further to those already noticed [*R.A.E.*, A **39** 73]. The adults normally emerge at flowering time. They were first observed in the field on 16th

March near Florence in 1947 and 1948, and on 21st and 24th March near Parma in 1949 and 1950, respectively. In the latter area, emergence in cages in the two years began some days before flowering, which lasted from 11th to 17th and from 1st to 11th April, respectively.

In the experiments in 1948, a spray of 2–3 per cent. quassia on 22nd or 27th March, during the flowering period, followed by one of 0·1 per cent. DDT, 0·2 or 0·12 per cent. BHC or 0·5 per cent. lead or zinc arsenate or a dust of 5 per cent. BHC on 13th April, after flowering, these post-blossom treatments being delayed by bad weather and thus affecting the larvae only during their later migrations from one fruit to another, reduced the percentage of fruits infested from 10·26 for no treatment to 2·1, 2·17, 0·68, 2·18, 3·12 and 6·97, respectively. There was no difference between 2 and 3 per cent. quassia.

In 1949, the percentage infestation was 17·54 on untreated trees, and this was reduced to 5·62–6·51 by 0·1 per cent. DDT and to 4·4 and 1·33 by 0·2 and 0·12 per cent. BHC, respectively, applied in pre-blossom sprays on 2nd April and post-blossom sprays on 16th April, to 12·29 by a post-blossom spray of 0·15 per cent. of a mixture of DDT and BHC, and to 5·12 and 4·9 by a pre-blossom spray of 0·12 per cent. BHC on 4th April followed by a 2 per cent. quassia on 12th April, during the blossoming period, and a post-blossom spray of either 0·1 per cent. DDT or 0·12 per cent. BHC on 18th April, respectively. The infestation on trees sprayed once with 1·5 or 2 per cent. quassia or 0·05 per cent. nicotine sulphate during flowering was considerably higher than in the controls.

In 1950, 30·75 per cent. of the fruits were infested in the controls, and this percentage was reduced to 1·24 by 0·2 per cent. BHC in a pre-blossom spray on 24th March and a post-blossom spray on 11th April, 5·24 by 2 per cent. quassia on 3rd April during flowering, 4·42 when this was followed by 0·5 per cent. lead arsenate on 12th April, after flowering, 0·54, 0·47–0·78, 1·24 and 0·35 by 2 per cent. quassia on 3rd April followed by 0·005 or 0·015 per cent. parathion, 0·1 per cent. HETP [hexaethyl tetraphosphate] and a mixture of 0·005 per cent. parathion with 0·015 per cent. chlorinated compounds in post-blossom sprays on 10th April, and 6·94 by 0·1 per cent. HETP, 26·66 by 0·2 per cent. BHC, 13·28 by 0·15 per cent. of the mixture of DDT and BHC, 1·75 by 0·005 per cent. parathion with 0·015 per cent. chlorinated compounds, and 16·01, 1·58–9·03 and 1·34 by 0·005, 0·015 and 0·02 per cent. parathion in post-blossom sprays on 7th–11th April.

It is concluded that two spray applications are desirable, one before, or preferably during, flowering against the adults, and one after flowering against late adults and larvae leaving their first infested fruits. BHC should be used before flowering, quassia during it and parathion after it. Parathion after flowering also affects the newly hatched larvae that have just entered the fruits.

Melis (A.). **Esperienze di lotta contro la mosca delle olive nella Toscana litoranea nel 1950.** [Experiments on the Control of *Dacus oleae* on the Coast of Tuscany in 1950.]—*Redia* **36** (1951) pp. 111–169, 12 figs. (1 fldg.), 2 refs. Florence [1952].

Fenili (G. A.). **Osservazioni sull'azione esplicata da alcuni insetticidi clorurati di sintesi sul *Dacus oleae* Gmel.** [Observations on the Action of some synthetic chlorinated Insecticides on *D. oleae*.]—*T. c.* pp. 231–244, 3 refs.

In the first of these papers, a detailed account is given of experiments carried out in 1950 on the control of *Dacus oleae* (Gmel.) on olive on the

coast of Tuscany [*cf. R.A.E.*, A **41** 174, etc.]. The results of the tests with parathion have already been noticed [**41** 178]. The chlorinated hydrocarbons tested, all of which were used at a dilution of 4 per cent. of the proprietary preparations and applied at intervals of about a month, comprised a fused powder containing 50 per cent. technical DDT, an emulsion concentrate of 50 per cent. chlordane and an emulsion concentrate containing 18 per cent. technical DDT and 32 per cent. chlordane, all applied four times from mid-July, an emulsion concentrate containing 25 per cent. DDT and 25 per cent. γ BHC, applied three times from mid-August, and a wettable powder containing 50 per cent. technical BHC, applied twice beginning in mid-July. In addition, a poison bait-spray of 2·5 lb. sodium arsenite and 100 lb. beet molasses diluted 1:10 in water was applied according to Berlese's method, in which all the trees are treated at once, and Bellio's modification of this for close planting, in which the trees are divided into groups of five and successive trees in each group sprayed at intervals of five days until all are treated, when the cycle recommences. Bait-spray treatments were begun in early July and the Berlese sprays were applied five times at intervals of about a month.

Counts were made throughout the season, and the last, in mid-November, showed that the approximate percentages of fruits infested on the treated trees and (in brackets) the respective controls were, on one variety of olive, 10 (31·9) for DDT and 80·9 (97) for BHC, and, on two varieties, 30·25 (92·2) and 13·3 (31·3) for chlordane, 17·4 (36·8) and 35 (66·6) for the mixture of DDT and chlordane, and 23·7 (95·9) and 12·5 (70) for the mixture of BHC and DDT. There was little difference in effectiveness between the two bait-spray treatments, both reducing infestation by up to about 25 per cent. in various tests. Bait-pans containing 5 per cent. diammonium phosphate were hung in treated and untreated trees, and the numbers of adults taken in them through the season are shown. The numbers did not always appear to be related to the populations present, and usually fell somewhat on both treated and untreated trees for a few days after each application of insecticide, but soon rose again. It is concluded that chlordane is promising for use against *D. oleae*, although it did not give good results in the previous year [*cf.* **41** 174].

In the second paper, the numbers of *D. oleae* taken in the bait-pans are discussed in relation to weather. Catches were greatest during periods of low temperature, southerly winds and cloudy skies, though there was a notable decrease when rain followed a drop in temperature. Experiments in which adults of *D. oleae* were caged in the laboratory with branches taken at various periods from the trees sprayed with the chlorinated hydrocarbons showed that the best results were given by the chlordane spray, which caused complete mortality for over a week after application. The mixture of chlordane and DDT was also very effective, and both gave the best results in hot weather.

Pegazzano (F.). **Contributo alla conoscenza del reale pericolo rappresentato dal carattere polifago dell'***Aspidiotus perniciosus* **Comst.** [A Contribution to Knowledge of the real Danger presented by the polyphagous Habits of *Quadraspidiotus perniciosus*.]—*Redia* **36** (1951) pp. 251–265, 14 refs. Florence [1952].

The author gives a list of the plants found by Melis to be infested by *Quadraspidiotus* (*Aspidiotus*) *perniciosus* (Comst.) in Italy [*cf. R.A.E.*, A **36** 64] and describes an experiment near Versilia, in the Province of Lucca, in which plants of 32 species and varieties commonly grown in central

Italy, excluding *Citrus* and ornamentals, were planted close together in 1946 in an area infested by *Q. perniciosus*. Of these, pear, apple, plum, peach, apricot, *Crataegus oxyacantha*, red currant, gooseberry, loquat and rose were attacked to a more or less serious extent in 1947. Further investigations were made in May 1950 when, in addition to these, cherry plum (*Prunus cerasifera* (*myrobalana*)) and almond were also fairly seriously attacked, and elm, pomegranate and *Robinia pseudacacia* were lightly infested, but cherry, quince, *C. azarolus*, walnut, hazel (*Corylus avellana*), fig, service tree (*Sorbus* (*Pyrus*) *domestica*), chestnut and *Cornus mas* were immune.

In the autumn of 1950, plants that had died in the interim were replaced. A final examination was made in the following August, when apple, peach, apricot, cherry plum, loquat, gooseberry, red currant, rose, blackberry and almond planted in 1950 were still free from infestation. Light infestations on pomegranate, elm and *R. pseudacacia* had died out within the year, and in addition to the plants previously immune, persimmon and olive were not attacked. A list is given of wild and cultivated plants on which *Q. perniciosus* was not found near Pistoia, and the part played by wild plants in the spread of infestation is briefly discussed.

Fenili (G. A.). **Nuovo contributo alla conoscenza della biologia della mosca delle ciliege (*Rhagoletis cerasi* L.) ed ai mezzi di lotta contro di essa.** [A new Contribution to the Knowledge of the Biology of *R. cerasi* and Methods of controlling it.]—*Redia* **36** (1951) pp. 267–275, 1 graph, 1 ref. Florence [1952].

In further studies in Italy in 1951 on the bionomics and control of *Rhagoletis cerasi* (L.) on cherry near Pisa, adults emerged between 9th May and 14th June from overwintered puparia kept in rearing cages [*cf. R.A.E.*, A **41** 179], with peaks on the 11th, 20th–21st and 25th May. Some of the adults were smaller than usual. Puparia obtained from infested fruits late in the season were again kept on moist sand for observations in the following spring.

Experiments on control were made on six trees, which were sprayed with a wettable powder containing 5 per cent. parathion diluted to give 0·25 per cent. of the product for the first application on 24th May and 0·3 per cent. for the second and third on 7th and 15th June. Infestation was heavier than in the previous year, and the percentages of infested fruits from the controls and the treated trees were 75·4 and 18·6, respectively, on 12th June, 83·1 and 24·8 on 23rd June, and 88·9 and 13·4 on 3rd July. The treatments also controlled *Caliroa limacina* (Retz.).

Pegazzano (F.). **Contributo alla conoscenza morfo-biologica del *Mytilococcus destefanii* Leon. (Hemiptera, Coccidae, Diaspinae).** [A Contribution to the Morphology and Biology of *Lepidosaphes destefanii*.] —*Redia* **36** (1951) pp. 291–299, 3 figs., 3 refs. Florence [1952].

Lepidosaphes (*Mytilococcus*) *destefanii* Leon., which had previously been recorded only on *Phillyrea media* in Sicily and Greece and on olive in Spain [*cf. R.A.E.*, A **14** 412; **41** 286, etc.], was observed in November 1949 on olive near Florence. The adult female and the crawlers are described. There was only one generation a year, the females laying an average of 21 eggs each in the second half of May. Hatching began at the beginning of June in the field and on 24th May on branches that had been kept in the laboratory for a week. The crawlers migrated along the branches, became

fixed by about mid-June and moulted during the second half of the month. The adult females appeared in September. No males were observed, but the females are probably fertilised before overwintering; microscopic examination showed that they contained mature eggs at the end of March. Trunks and branches of all ages were infested, but the damage caused was slight. Later investigations showed that the Coccid was present on olive throughout Tuscany and in part of Liguria.

Bartoloni (P.). **La *Phthorimaea operculella* Zeller (Lep. Gelechiidae) in Italia. (Note sulla morfologia, biologia e mezzi di lotta.)** [*Gnorimoschema operculella* in Italy. (Notes on its Morphology, Bionomics and Control.)]—*Redia* **36** (1951) pp. 301–379, 29 figs., 108 refs. Florence [1952].

Gnorimoschema operculella (Zell.) was stated not to be present in Italy in 1935 [*R.A.E.*, A **25** 285] but is now widely distributed and injurious to potato on the mainland and in Elba, having apparently been introduced with imported tubers under war conditions about 1944. All stages of the moth are described, and an account is given of investigations in 1949–52 on its bionomics in the Province of Pisa and in Elba and on its control. In addition to potato, on which infestation continues throughout the year in the field or on the stored tubers, tobacco, tomato, peppers (*Capsicum annuum*), egg-plant (*Solanum melongena*) and wild Solanaceae are attacked on the mainland, but tomato and egg-plant were not infested in Elba even when growing close to infested potato.

On potato, the eggs are usually laid in the eyes of the tubers or near veins in the leaves, and the larvae mine the tubers, leaves and stems. In laboratory studies, females laid 30–80 eggs each, and the egg stage lasted 4 days in July–August, 15–17 in October and 29 in November–December. The duration of the larval stage in the tubers varied from 14 days in June–August to 68–97 in November–March, and the pupal stage varied from 4 days in July to 36–97 in November–March. A generation was completed on the tubers in 26–28 days in summer and about 140 in winter, but 6–7 days more were required on the growing plants in summer than on the stored tubers. Six generations were reared in a year in a potato warehouse at Pisa, and seven in the laboratory when the temperature was kept at 18°C. [64·4°F.] from November to January. Lists are given of the wild and cultivated solanaceous food-plants of *G. operculella* found in Italy and in the Province of Pisa, and it is shown that with the possible exception of *Datura stramonium*, these do not permit development in the field during winter, so that the later generations are restricted to the stored potato tubers. In Elba, only the first generation developed on potato in the field, all subsequent ones occurring on stored tubers. Although the autumn population in stores was large, few adults emerged in spring owing to the fatal effects of low temperatures [*cf.* **32** 128] and the destruction of decayed tubers. A list of the natural enemies of the moth is given; none is known to occur in Italy, and *Arrenoclavus (Copidosoma) koehleri* (Blanch.), which was introduced against it [**39** 58], has apparently not been recovered.

Control methods are reviewed from the literature [*cf.* **39** 324, 326, etc.]. In experiments in Elba, sprays containing 0·008–0·0125 per cent. parathion killed over 90 per cent. of the larvae in the leaves of lightly infested plants in the field, but only 3 per cent. of those in the tips, whereas one of 0·125 per cent. DDT gave over 90 per cent. mortality of all larvae, though some in the tips were not killed until they left their mines to pupate. There was little difference, however, in the infestation of tubers from treated and

untreated plants. In laboratory tests, eggs placed on potato tubers and dusted with 10 per cent. DDT hatched, but the larvae all died in 12 hours, and full-fed larvae and adult females confined on dusted surfaces died in 36 and 15–24 hours, respectively. When the surfaces had been sprayed with 0·5 per cent. γ BHC, larvae and adults confined on them died in 46 and 16–26 hours, respectively. When the 10 per cent. DDT dust was applied to the tubers as they were being stored, they were completely protected from attack, whereas infestation in the controls reached 90–100 per cent. Sound tubers stored in layers of sand were protected for 8–9 months. Fumigation of infested tubers with carbon bisulphide [*cf.* **35** 289] at 30–80 oz. per 1,000 cu. ft. space, according to temperature, gave 90–95 per cent. mortality of the larvae.

The control methods recommended for Elba are the removal of wild and other cultivated solanaceous plants from the neighbourhood of potato fields, the use of early varieties, planting in light sandy soil (to avoid cracks that expose the tubers), prompt removal of tubers to storage premises, storage at temperatures below 10°C. [50°F.], and protection of the stored tubers with DDT or sand.

Pegazzano (F.). **Contributo alla conoscenza dei mezzi di lotta contro alcune specie di insetti nocive ai fruttiferi.** [A Contribution to Knowledge of Control Methods against certain Species of Insects injurious to Fruit Trees.]—*Redia* **36** (1951) pp. 381–409, 10 tables (3 fldg.), 10 refs. Florence [1952].

The experiments described were carried out in three localities in north-central Italy in 1950–51 and concerned the control of *Quadraspidiotus* (*Aspidiotus*) *perniciosus* (Comst.) and Aphids on apple, pear and peach and of *Cydia pomonella* (L.) on apple and pear.

In tests of winter treatments against the Coccid, the trees were sprayed in February or March and the results were estimated 40 days later. Many of the plots subsequently received spring treatments against the Aphids, which may have had some effect on the first-generation crawlers, and the percentages of fruits infested by the Coccid were ascertained in September for trees that had not been harvested earlier.

In 1950 in Parma, where infestation was moderate, sprays of 5 or 6 per cent. tar distillate (anthracene oil) with 22 per cent. lime-sulphur (30–32° Bé.) on 20th or 23rd February or of 5 or 6 per cent. tar distillate with 7 per cent. barium polysulphide on 21st or 23rd February gave 98–98·5 per cent. mortality of *Q. perniciosus* on pear. When a spray of 0·02 per cent. TEPP (tetraethyl pyrophosphate) followed, on 13th May, infestation of the fruits was 0·5 per cent., as compared with 60 per cent. for no treatment at all. In Pistoia, where infestation was moderate to heavy, 7 per cent. tar distillate on 10th February followed by 10 per cent. lime-sulphur on 4th March gave 98 per cent. mortality on pear, and after a spray of 2·5 per cent. nicotine sulphate on 20th May, the percentage infestation of the fruits was 0·5 as compared with 80 for no treatment. In Lucca, infestation was heavy, but 5 per cent. tar distillate on 15th February gave 99·6 per cent. mortality on pear, apple and peach and only 12 per cent. of the pear fruits were infested, as compared with 100 per cent. for no treatment. Other sprays were less effective.

In the further tests in 1951, sprays of 6·5 per cent. tar distillate or of 1 per cent. DNC in 2 per cent. winter oil on 18th–19th January followed by 10 per cent. lime-sulphur on 22nd February gave 99·2–99·5 per cent. mortality on pear in Parma as compared with 12·3–18·2 per cent. for no

treatment, and in one test in Pistoia, 6 per cent. of a proprietary preparation of DNC in tar distillate in early February, alone or followed by 2 per cent. barium polysulphide in late March, or of 6 per cent. barium polysulphide alone in February gave 98·5–99·5 per cent. mortality on apple and pear. Spring treatments of 0·02 per cent. parathion were applied on 15th–17th May and the percentage infestation of the fruits was 0·5–10, as compared with 86 for no treatment. In another test in Pistoia, sprays of 6 per cent. tar distillate or 6 per cent. of the preparation of DNC in tar distillate on 20th February, both followed by 2 per cent. barium polysulphide on 15th March, and of 5 per cent. of a proprietary preparation of DNC in winter oil on 9th February, 5 per cent. tar distillate with 20 per cent. lime-sulphur on 18th March or 5 per cent. winter oil on 20th March gave 98·3–99·5 per cent. mortality on apple, as compared with 13·5 per cent. on the controls, and the percentage infestation of fruits was reduced from 64 to 0·5–2·5. Apple trees in Lucca sprayed with 6 per cent. of the preparation of DNC in tar distillate on 16th–17th March or 4 per cent. of the preparation of DNC in winter oil on 1st February showed 98·1–99·4 per cent. mortality, as compared with 10–28·1 per cent. for no treatment, and 2 per cent. of the fruits on the former were infested, as compared with up to 100 per cent. Other treatments were again less effective.

The Aphids present were *Anuraphis* (*Yezabura*) spp. and *Aphis pomi* Deg. on apple and pear and *Anuraphis* (*Brachycaudus*) *persicae-niger* (Smith) on peach. With the exception of *Aphis pomi*, all were effectively controlled by the various spring treatments, 0·02 per cent. parathion, which was more effective in an emulsion than as a wettable powder, proving the best.

It was observed in 1951 in Lucca that infestation by *C. pomonella* was considerably lower on trees sprayed with tar distillate or with DNC in winter oil than on trees receiving no winter treatments. In Parma, seven applications in May–August of 0·4–0·6 per cent. lead arsenate, with bordeaux mixture, copper oxychloride, 0·02 per cent. parathion or 0·1 per cent. of a preparation containing 5 per cent. parathion and 15 per cent. chlorinated compounds added to some of them, reduced the percentages of apple and pear fruits attacked from 32 and 25 to 2 and 1·5–2, respectively. In Pistoia, where lead arsenate was used at 0·5 per cent. and bordeaux mixture was added in 2–3 applications, the percentage infestation on apples and pears in September was reduced from 50–60 to 1 by three applications, to 0–1·5 by four and to 0·1 by five in one orchard and from 65 to 2–10 by 3–4 applications in another.

Ciampolini (M.). **Nuovo contributo alla conoscenza dell'azione che gli esteri fosforici esplicano sul *Dacus oleae* Gmel.** [A new Contribution to Knowledge of the Effect of phosphoric Esters on *D. oleae*.]—*Redia* **36** (1951) pp. 423–431, 1 ref. Florence [1952].

Further experiments were made on the coast of Tuscany in 1951 on the effect of parathion on the immature stages of *Dacus oleae* (Gmel.) on olive [*cf. R.A.E.*, A **41** 178]. The trees were treated on 5th and 19th September and 5th and 21st October with a dust of 4 per cent. parathion or a suspension spray of 0·4–0·6 per cent. of a material containing 20 per cent. parathion, and fruits were taken daily for a week from each group of trees and examined. It was found that the eggs, pupae, newly hatched larvae and larvae about to pupate were unaffected, but that almost all the larvae in intermediate stages of development died within 2–3 days of the treatment. The sprays were generally more effective than the dust. Similarly, when branches of the treated trees were caged and the fruits examined after 10–15

days, all the larvae in them except those about to pupate were found to have died. Larvae in all stages were again present 8–10 days after treatment. The percentage infestation of the fruits on 30th November was reduced from nearly 93·2 for no treatment to 56 by the dust and to 21·2–49·4 by the sprays. These results are taken to indicate that the parathion penetrated into the fruits and that it then acted mainly as a stomach poison [*cf.* **41** 47].

CALL (F.). **Apparatus for the Determination of low Concentrations of Methyl Bromide and other Gases.**—*J. Sci. Fd Agric.* **3** no. 10 pp. 463–470, 6 figs., 9 refs. London, 1952.

The following is the author's summary. A method is described for the determination of low concentrations (0·01–1·0 mg./l.) of methyl bromide, based on the length of the colour stain produced by the reaction of the bromine in the combustion products with fluorescein paper. The length of the stain is directly proportional to the concentration, provided certain factors are controlled. The effect of these factors is discussed and an apparatus is described which automatically controls them. The method has been shown to be applicable to hydrogen cyanide and carbon tetrachloride, and it is believed to be suitable for any gas for which a suitable test paper exists.

BLACKITH (R. E.). **Stability of Contact Insecticides. III. Allethrin, DDT and BHC in ultra-violet Light.**—*J. Sci. Fd Agric.* **3** no. 10 pp. 482–487, 3 graphs, 21 refs. London, 1952.

In this third part of a series [*cf. R.A.E.*, A **40** 297], an account is given of tests on the effect of irradiating allethrin, DDT and BHC with ultra-violet light. As a preliminary experiment showed that natural pyrethrins were 4·85 times as toxic as allethrin to *Calandra granaria* (L.) when assayed by a procedure already described [**39** 50], filter paper was treated with a solution of pyrethrins at 2 per cent. alone or at 1 per cent. with 1 per cent. of the dye, benzeneazo-β-naphthol [*cf.* **40** 297], or with one of allethrin at 9·72 per cent. alone or at 4·85 per cent. with 1 per cent. of the dye, irradiated for eight minutes and assayed as before. Allethrin proved more stable than pyrethrins to ultra-violet photolysis, but was significantly less well protected by the dye, so that the materials had a similar stability in protected films.

In view of difficulties in the evaluation of irradiated DDT deposits by chemical methods, which are discussed, a bioassay method was used. Solutions of 2, 1 and 0·5 per cent. p,p′DDT in a mixture of volatile and non-volatile oils were applied to filter papers, and the deposits were irradiated for 10, 15 or 20 minutes. Adults of *C. granaria* were confined on the papers at 25°C. [77°F.], and mortality was recorded. The results showed that irradiation decomposed the DDT at a rate corresponding to a reduction to 25 per cent. of the original DDT present in 15 minutes, which is almost identical with that found for pyrethrins under the same conditions [*cf.* **40** 297]. The addition of 1 per cent. benzeneazo-β-naphthol had the same effect on 2 per cent. DDT as on pyrethrins, doubling the life of the film in ultra-violet light. When 1 per cent. benzil and the saturation concentrations of β-methyl-anthraquinone and p-benzoquinone, all of which have been claimed to be synergists for DDT, were added to films of 1 per cent. DDT in oil, they had no significant effect on stability.

Irradiation of filter papers impregnated with 0·02 per cent. γ BHC for 5, 10 or 15 minutes had no effect on toxicity to adults of *C. granaria*, as was to be expected, since BHC is formed by irradiating a mixture of chlorine and benzene.

Lickerish (L. A.). **Studies on commercial Octamethylpyrophosphoramide (Schradan). V. Insecticidal Comparisons of the two main Constituents.** —*J. Sci. Fd Agric.* **4** no. 1 pp. 24–28, 7 refs. London, 1953.

In the tests described in this part of a series [*cf. R.A.E.*, A **40** 290], schradan and its higher homologue, triphosphoric acid penta(dimethylamide), which are the main constituents of Pestox 3 [*cf.* **40** 147], were compared as systemic insecticides. Pure schradan and a mixture of 23·4 per cent. schradan with 76·6 per cent. of the homologue were applied at various concentrations as sprays to rooted chrysanthemum cuttings and broad-bean seedlings, and the chrysanthemums were infested with *Myzus* (*Aulacorthum*) *circumflexus* (Buckt.), *Rhopalosiphum* (*Coloradoa*) *rufomaculatum* (Wils.) and *Macrosiphum* (*Macrosiphoniella*) *sanborni* Gill. and the beans with *Aphis fabae* Scop. and *Megoura viciae* Buckt. 24 hours after treatment and examined for Aphid mortality after various periods.

The results showed a different level of susceptibility to the insecticides and a different rate of increase in percentage mortality with concentration for each species of Aphid. The relative effectiveness of schradan and the mixture varied with the different species and at different concentrations. Statistical analysis showed that the toxicity of the mixture was never as low as 23·4 per cent. of that of pure schradan, so that the triphosphoric acid penta(dimethylamide) must have had some insecticidal effect. The mixture was usually less toxic than schradan alone, which is partly explained by the slower rate of absorption of the homologue into the plant [*cf.* **40** 291], but was more toxic to *M. viciae* at all concentrations and to the other Aphids at some, and it is concluded that the homologue has the same order of toxicity as schradan, though it is rather more toxic to some insects and rather less so to others.

Brown (W. B.) & Heuser (S. G.). **Behaviour of Fumigants during Vacuum Fumigation. I. Penetration of Methyl Bromide into Boxes of Dates.**— *J. Sci. Fd Agric.* **4** no. 1 pp. 48–57, 8 graphs, 8 refs. London, 1953.

In Britain, fumigation of stored products is usually carried out at atmospheric pressure, but in the United States, Canada and France, techniques involving reduction of pressure are used. These are of two main types. In the first, or sustained-vacuum method, the pressure is reduced to about 5 cm.mercury and the fumigant is then introduced. This causes a slight rise in pressure, but no further increase is allowed until the end of fumigation, when air is introduced, usually followed by re-evacuation once or twice (air-washing) to remove residual fumigant. In the second, or released-vacuum method, the fumigant is introduced into the evacuated chamber and the pressure immediately raised to about atmospheric by allowing air to enter, but in a French variation of this, a mixture of air and vaporised fumigant in the correct proportions is introduced until atmospheric pressure is almost reached.

It has been considered that penetration of fumigants into packages is more effective at reduced than at atmospheric pressure and that early release of the vacuum drives the fumigant into the commodity, thus rapidly

establishing an even distribution, and comparative tests indicated that treatment is effective in 2–4 hours under vacuum as compared with 18–24 hours or more at atmospheric pressure. Vacuum fumigation has been claimed to be effective for commodities that are particularly difficult to fumigate because of the nature of the material or the manner in which it is packed. The results are given of a series of tests in which 140-lb. bags of wheat or shelled groundnuts and 70-lb. wooden cases of compressed dates were fumigated with methyl bromide and the behaviour of the fumigant was studied by measurement of concentrations. For each experiment, the nominal concentration was calculated from the weight of fumigant applied and the volume of the fumigation chamber. The concentrations found in the free space in the chamber and within the packages were plotted against time, and curves were drawn to show the probable variation of concentration with time. Areas below the curves were measured to provide estimates of the concentration-time products in selected fumigation periods in mg.hr. per litre, and the efficiency of penetration of the fumigant (penetration factor) was determined by expressing these products as percentages of the products of nominal concentration and the selected time.

Treatments with methyl bromide at a nominal concentration of 30–37 mg. per litre at atmospheric pressure and by the French released-vacuum method resulted in penetration factors of 72 and 77, respectively, in wheat, 71 and 86 in groundnuts and 3–10 and 32 in dates after three hours; in the atmospheric fumigations, the penetration factors after 24 hours were 72, 65 and 27–33 for wheat, groundnuts and dates, and it is concluded that this method is adequate for all three commodities, but that methods employing reduced pressure might be more effective for dates.

Concentration-time curves showed that in the French released-vacuum treatment, the fumigant was carried rapidly to the centre of each package, where immediate sorption of the fumigant caused a rapid fall in concentration; later, the concentration increased again owing to normal diffusion at atmospheric pressure. Diffusion was much slower into dates than into wheat or groundnuts, and sorption continued to reduce concentration for more than 30 minutes. As the penetration factor was about the same after 24 hours at atmospheric pressure as after three by the French released-vacuum method, a much higher dosage would be required for insect control by the latter. When single boxes of dates were fumigated by the sustained-vacuum method at a nominal concentration of 96 mg. per litre, the penetration factors after three hours were 38–45, indicating that penetration by this method was rather better than by the French released-vacuum method and much better than by fumigation at atmospheric pressure. After the release of the vacuum, there was a considerable increase in concentration at the centre of the box, the maximum reached being about four times that in the free space. In current vacuum-fumigation practice, the chamber is re-evacuated immediately after the vacuum is released (air-washing), but it seems probable that a marked increase in efficiency might result if air were admitted after a period of treatment under reduced pressure and the treatment continued for a further period before any fumigant is removed from the chamber. Measurements of concentration at the centres of a single box and of a stack of 12 boxes of dates fumigated at 96 mg. per litre for 4 hours 10 minutes with the vacuum released after 190–210 minutes showed that the penetration factors were about twice as great as they would have been had the vacuum been maintained throughout.

The concentration of methyl bromide at the centres of two boxes of dates fumigated by the sustained-vacuum method with a nominal concentration of 85 mg. per litre was probably not less than 20 mg. per litre after the first release of vacuum and re-evacuation, 6 and 11 mg. per litre after the

second re-evacuation and 13 mg. per litre after the final release of vacuum, when the concentration in the free space was 1·2 mg. per litre, and it is concluded that care must be taken that those unloading vacuum chambers are not exposed to fumigant that may be released from the commodity even after two air-washing cycles.

Hayes jr. (W. J.), Ferguson (F. F.) & Cass (J. S.). **The Toxicology of Dieldrin and its Bearing on Field Use of the Compound.**—*Amer. J. trop. Med.* **31** no. 4 pp. 519–522, 2 graphs. Baltimore, Md., 1951.

In view of the promise shown by deposits of dieldrin against a variety of insects, the hazard involved to those who applied it was examined. Experiments with many kinds of laboratory animals indicated that one contamination of the skin with 100 cc. or more of a 25 per cent. solution might be dangerous to a man if not washed off promptly, but minor daily contamination with the emulsified solutions used for spraying under field conditions might not. Technical powder was absorbed by the unabraded skin practically as readily as solutions in organic solvents. The symptoms of dieldrin poisoning are described. Barbiturates have shown some promise as antidotes.

In limited operational control experiments in various States, workmen received no apparent injury. It is concluded that dieldrin can be safely used in public health programmes by properly trained personnel in sprays to apply insecticide deposits outdoors.

Cox (H. C.) & Lilly (J. H.). **Chemical Control of the Corn Rootworm.** —*J. econ. Ent.* **46** no. 2 pp. 217–224, 6 refs. Menasha, Wis., 1953.

Diabrotica longicornis (Say) is an important pest of maize in the Middle West of the United States, affecting yield directly by damaging the plants so as to reduce ear size and indirectly by causing plant lodging and subsequent ear losses during mechanical picking, and aldrin, dieldrin and chlordane were tested in wettable powders mixed with sand or fertiliser and these materials and BHC, DDT and heptachlor in emulsion concentrates in sprays for its control in Iowa in 1951 and 1952.

Aldrin, chlordane and dieldrin at 1 lb. per acre caused highly significant reductions in populations of larvae, pupae and newly emerged adults in and round the roots in 1951 when applied with fertiliser by means of a standard fertiliser attachment at the time of planting, and aldrin and chlordane applied in the same way and at the same rates but mixed with sand gave good control in 1952. Aldrin and γ BHC at 8 oz. and chlordane and dieldrin at 12 oz. per acre were effective when sprayed on ploughed soil and disked in before planting in 1952. Aldrin, chlordane, dieldrin and heptachlor at 8 oz. per acre also gave good control when applied over the planter shoe trench by means of a planter-mounted sprayer. In a single experiment, 8 oz. aldrin, chlordane or dieldrin per acre, mixed in fertiliser and side-dressed along the rows with a deep-placement machine after the plants had appeared, failed to reduce rootworm populations. All insecticides but DDT (used at 3 lb. per acre) and all methods of application except side-dressing by deep placement resulted in significant decreases in lodging, as also did applications of aldrin and γ BHC at 8 oz. per acre sprayed in a band on the soil along the rows when the plants were about 3 ft. high, for which no records of infestation or yield were taken. Only applications at planting time in mixtures with fertiliser or sand resulted in significant increases in

yield. Chlordane and dieldrin appeared to be less effective than aldrin in reducing insect populations, but resulted in higher yields. None of the materials injured the plants.

HOFMASTER (R. N.) & GREENWOOD (D. E.). **Control of Mites on Strawberries in Virginia.**—*J. econ. Ent.* **46** no. 2 pp. 224–233, 3 refs. Menasha, Wis., 1953.

Of the mites that attack strawberry in south-eastern Virginia, *Tetranychus bimaculatus* Harvey [*cf. R.A.E.*, A **39** 382] and *T. atlanticus* McG. are the most important and cause general loss of vigour, yield reduction and permanent stunting or death. Investigations on control were carried out against the first in 1951 and the second in 1952 with special reference to treatment in cold weather, since damaging infestations often occur in late winter or early spring, when adequate protection is difficult to obtain. Dusting with sulphur, 1 per cent. parathion in sulphur or 1 per cent. TEPP (tetraethyl pyrophosphate) has given good control in late spring, but 3–4 applications are usually necessary.

Systox (an emulsion concentrate containing 32·1 per cent. O,O-diethyl O-2-(ethylmercapto)ethyl thiophosphate [demeton]), tested at rates of 0·25–4 U.S. pints per acre in sprays, was generally effective in both years over a wide range of temperature and plant conditions. Excellent control was obtained early in the season with 1 U.S. pint concentrate per acre at a temperature of about 50°F., when the plants were semi-dormant, but in 1952, a combination of low temperatures (25–28°F.) and plant dormancy reduced control at rates below 1 U.S. quart per acre. Treatment with 0·5 U.S. pint per acre gave fairly good initial control of both mites, but a relatively short period of protection. Treatment in 1952 with 1 and 1·5 U.S. pints of a 48·1 per cent. demeton emulsion concentrate a month and six weeks, respectively, before picking appeared to ensure good control throughout the harvest period.

Dusts of 1 per cent. parathion with 5 per cent. Ovotran (p-chlorophenyl p-chlorobenzenesulphonate) or alone in sulphur applied at 35 lb. per acre on 30th April when the temperature was 70°F., gave more than 95 per cent. reduction in *T. bimaculatus* 5 and 15 days later and were more effective than sulphur, 1 per cent. parathion or 5 per cent. Ovotran alone. Ovotran was comparatively slow in action but showed good residual properties. Dusts containing 10 per cent. p-chlorophenyl phenyl sulphone or 5 per cent. dinitrocaprylphenylcrotonate showed promise. A commercially prepared dust of 3 per cent. Aramite (2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite) and one containing 10 per cent. Ovotran gave the best results of any dusts applied at about 35 lb. per acre in early spring (14th–17th April) against *T. atlanticus* and 2 per cent. Compound 338 (ethyl ester of 4,4′-dichlorobenzilic acid) [*cf.* **41** 300] showed promise; commercially prepared Aramite was much superior to Aramite dusts blended from a wettable powder. In late-spring applications on 1st May against the same mite, dusting with 5 per cent. malathon or NPD (tetra-n-propyl dithionopyrophosphate) at about 40 lb. per acre gave about 90 per cent. reduction 18 days after treatment and were more effective than other dusts; 1 per cent. TEPP gave a high initial kill but had little residual toxicity.

Bioassay showed only 0·1 part demeton per million on fruit harvested eight days after the application of 1 U.S. pint Systox per acre in 1951, and no measurable residues were found by the cholinesterase method after treatment with the compound in 1952. Residues of Ovotran, NPD and Compound 338 were relatively low 3–4 weeks after application, and fruit treated

with malathon showed 2·7 p.p.m. and no residue after three and ten days, respectively.

Dipping strawberry plants in 1 quart Systox per 100 gals. water before transplanting greatly decreased damage by mites during the first season.

Neiswander (R. B.). **Control of the Black Vine Weevil.**—*J. econ. Ent.* **46** no. 2 pp. 234–237, 7 refs. Menasha, Wis., 1953.

Otiorrhynchus (*Brachyrrhinus*) *sulcatus* (F.) is injurious to the roots of *Taxus* in nurseries in Ohio. It has only one generation a year. The adult weevils appear in June and early July, feed on the foliage at night, and hide in débris under the plants during the day; eggs are dropped to the ground during July and August. The chief damage is due to the destruction of the roots by the larvae.

In tests on control in 1950, insecticides were mixed with fertiliser and worked into the soil between the rows on 31st May, when the insects were still in the larval and pupal stages. Aldrin, dieldrin and heptachlor at 10 lb. per acre were very effective against the adults and prevented infestation by larvae of the new generation. Chlordane at 10 lb. was more effective than EPN [O-ethyl O-p-nitrophenyl benzenethiophosphonate] at 10 lb., DDT at 25 lb. or BHC at 2 lb. γ isomer per acre, but all permitted some infestation by larvae. Investigations in which chlordane was applied in late 1950 and 1951 indicated that foliage applications were more effective than soil treatments, and foliage sprays were further tested in 1952. When applied in 100 U.S. gals. on 16th and 17th June, 4 lb. wettable 20 per cent. aldrin, 25 per cent. dieldrin or 25 per cent. heptachlor gave consistently good control of the adults, 2 lb. 50 per cent. wettable chlordane and 2 U.S. quarts 25 per cent. DDT emulsion concentrate were very effective, 4 lb. 25 per cent. wettable malathon and 3 lb. 15 per cent. wettable parathion were less so, and 4 lb. 10 per cent. wettable BHC gave good initial control but had little residual effect. The sprays were applied liberally so as to cover the inner branches of each plant, where the weevils feed and the deposits remain effective for a relatively long time.

Since the preoviposition period of *O. sulcatus* is long [*cf. R.A.E.*, A **21** 194], spraying can safely be delayed until nearly all the insects have reached the adult stage. In northern Ohio, where most of the nurseries are situated, the best time will usually be during the last week in June or the first in July.

Wilson (M. C.) & Davis (R. L.). **Varietal Tolerance of Alfalfa to the Meadow Spittlebug.**—*J. econ. Ent.* **46** no. 2 pp. 238–241, 2 graphs, 1 ref. Menasha, Wis., 1953.

The following is based on the authors' introduction and summary. *Philaenus leucophthalmus* (L.) has become increasingly injurious to lucerne and red clover in Indiana since 1947 and now reduces hay yields throughout the State. In investigations in 1950–52 on the varietal tolerance of 26 selections of lucerne, information on damage, yield and stand were obtained in all three years and on actual spittlebug populations in two. There were significant correlations between populations and damage, damage and yield, and yield and stand, but not between damage and stand, independent of yield, and a highly significant correlation between damage and yield, independent of stand. It is concluded that lucerne selections vary in attractiveness to the spittlebug, and that some are tolerant of injury in spite of high attractiveness.

Davis (R. L.) & Wilson (M. C.). **Varietal Tolerance of Alfalfa to the Potato Leafhopper.**—*J. econ. Ent.* **46** no. 2 pp. 242–245, 1 graph, 8 refs. Menasha, Wis., 1953.

The following is based on the authors' summary. *Empoasca fabae* (Harr.) has long been an important pest of lucerne in Indiana, and data were obtained in 1950–52 on the relation between the population of the leafhopper and plant discoloration or damage, with subsequent effects on stand and yield. The results indicated that varieties showing little damage may be either unattractive or tolerant of infestation. Yield differences ceased to exist when corrected for stand differences, and leafhopper damage appeared to be associated with stand reduction rather than yield per plant, since there was a significant correlation between stand and damage, but not between damage and yield corrected for stand.

Connola (D. P.), Yops (C. J.), Wilcox (J. A.) & Collins (D. L.). **Survey and Control Studies of Beetles attacking windthrown Trees in the Adirondacks.**—*J. econ. Ent.* **46** no. 2 pp. 249–254. Menasha, Wis., 1953.

Strong winds in November 1950 caused extensive damage over 343,000 acres of the Adirondack forests in New York, partly or completely blowing down many trees, particularly red spruce [*Picea rubra*], and increasing the susceptibility of others to insect attack and other unfavourable factors. Since infestation by beetles was inevitable, three plots, differing in soil, moisture and exposure conditions, were selected for observations to determine the species present, whether salvage operations could be carried out before serious injury was caused, whether conditions would favour an increase in *Dendroctonus piceaperda* Hopk. to such an extent that living standing trees would be attacked by it, and whether spraying, particularly from aircraft, would prevent infestation by insects. The plots were sprayed from a helicopter in 1951 and from an aeroplane in 1952. The sprays were solutions of DDT or BHC, and applications were made in May–July, but infestation by ambrosia beetles, bark-beetles, Longicorns, Buprestids and weevils was not reduced in either year. Hand treatment was more effective, spraying large sections of fallen red-spruce trunks with emulsified solutions of 0·125–1 per cent. γ BHC as lindane on 30th May or 12th June giving complete protection from weevils (which were rare on untreated boles), Longicorns and bark-beetles, including *D. piceaperda*, and reducing attack by ambrosia beetles in proportions increasing with the concentration.

The species of beetles found in or on wind-thrown trees in the three plots and in 30 other sites in the area are listed, and notes are given on their abundance and the trees attacked. Populations increased greatly between 1951 and 1952. Most of the softwood became generally infested in 1951, but thereafter ceased to be susceptible to attack by ambrosia beetles or borers that attack green timber. Most of the hardwood did not die until the summer of 1952 and was still subject to attack by ambrosia beetles. There were indications at the end of the period that secondary species predominated in most places, so that the primary pests were likely to encounter severe competition.

Langford (G. S.), Harding (W. C.) & Lall (B. S.). **Newer Insecticides for Japanese Beetle Control.**—*J. econ. Ent.* **46** no. 2 pp. 262–265, 7 refs. Menasha, Wis., 1953.

An account is given of experiments in Maryland in which Dilan (a mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane [1:2]), malathon, EPN (O-ethyl O-p-nitrophenyl

benzenethiophosphonate), NPD (tetra-n-propyl dithionopyrophosphate) and Metacide (6·2 per cent. parathion, 24·5 per cent. methyl-parathion and 2·7 per cent. related organic phosphates) and two systemic insecticides, Systox, containing 32·1 per cent. active ingredient [O,O-diethyl O-2-(ethylmercapto)-ethyl thiophosphate (demeton)] and schradan, were compared with DDT, methoxy-DDT (methoxychlor) and γ BHC as lindane for toxicity to adults of the Japanese beetle [*Popillia japonica* Newm.]. All materials were in the form of emulsion concentrates, except EPN, which was a wettable powder, and the quantities given below are the amounts of toxic ingredient per 100 U.S. gals.

In the laboratory, beetles collected in the field were either sprayed with a hand atomiser, dried with absorbent paper and caged with fresh grape leaves or confined on grape leaves that had been sprayed in the laboratory or field. All the compounds proved toxic and none of them damaged the leaves. When applied directly to the beetles, Metacide at 0·5 oz., Dilan and Systox at 4 oz., γ BHC at 1 oz., methoxy-DDT at 1 lb., EPN, malathon and NPD at 2 lb. and schradan and DDT at 3 lb. gave complete mortality in 24 hours. Metacide at 2·7 oz., Dilan at 4 oz., NPD and EPN at 3 lb. and DDT at 1 lb. gave very good kills and 2·7 oz. γ BHC and 1 lb. malathon fairly good kills of beetles confined on treated leaves immediately or one day after spraying, whereas Systox at 4 oz. was rather less effective; all these materials showed reductions in toxicity after two and three days, Systox, γ BHC and EPN losing toxicity rapidly after the second day. Schradan and methoxy-DDT were not tested in this way.

Dilan proved remarkably effective; it gave practically complete knock-down in the laboratory in half an hour at 4 oz. and remained toxic for seven days when applied to foliage at about 5·3 oz. In the field, complete kills were obtained at 4 oz. and satisfactory kills at 1 oz., but a concentration of about 5·3 oz. is probably advisable for commercial application. Systox and schradan were slow in knockdown, and leaves heavily sprayed with them in the field gave insignificant kills of beetles confined on them for 24 hours five days later.

Flanders (S. E.). **Variations in Susceptibility of *Citrus*-infesting Coccids to Parasitization.**—*J. econ. Ent.* **46** no. 2 pp. 266–269, 6 refs. Menasha, Wis., 1953.

Almost all the most important insect pests of *Citrus* in California are Coccids not native to the State, and biological control has been attempted on a large scale. Numerous Hymenopterous parasites have been introduced against them in the last 50 years, and *Coccus hesperidum* L., *Saissetia nigra* (Nietn.) and *Pseudococcus gahani* Green are now commercially controlled by *Metaphycus luteolus* (Timb.), *M. helvolus* (Comp.) and *Tetracnemus pretiosus* Timb., respectively, throughout California, and *Icerya purchasi* Mask., *Planococcus* (*Pseudococcus*) *citri* (Risso), *Pseudococcus adonidum* (L.), *Aonidiella citrina* (Coq.), *A. aurantii* (Mask.) and *S. oleae* (Bern.) by *Cryptochetum iceryae* (Will.), *Leptomastidea abnormis* (Gir.), *Anarhopus sydneyensis* Timb., *Comperiella bifasciata* How., *Aphytis chrysomphali* (Merc.) and *M. helvolus*, respectively, in certain areas.

The rearing of numerous introduced parasitic Hymenoptera on various species of scales and mealybugs in 1924–52 indicated that Coccids vary greatly in susceptibility to different species of parasites. In any particular environment, parasites and Coccids may be in equilibrium, although this may not result in commercial control, but parasitism may be only occasional if the host does not usually stimulate oviposition by the parasite, physiologically incomplete if the host stimulates maximum oviposition but causes

a high mortality of the immature stages of the parasite, or ecologically incomplete if the parasite does not attack a highly suitable host in all the habitats in which both are present. Examples are given of species exhibiting the three types of incomplete parasitism of *Aonidiella aurantii* and of ecologically incomplete parasitism of other scales and mealybugs.

Morril jr. (A. W.). **Army Insect Control Operations in the Far East.**—*J. econ. Ent.* **46** no. 2 pp. 270–276. Menasha, Wis., 1953.

An account is given of work on the control of insect pests carried out in the Far East under the direction of the U.S. Army since the end of the Second World War, some of which is noticed elsewhere [*R.A.E.*, B **41** 172]. Termites became a problem in buildings. In the Philippines, *Macrotermes gilvus* (Hagen) constructed its mounds under floors, unsteadying the structure and affording entry for rats, and *Coptotermes vastator* Light fed on the structural timbers. Since it was not always possible to control the latter by soil treatment without damaging or destroying cement or tile flooring, the mud tunnels were broken open and 10 per cent. DDT dust was blown into them. This eliminated the colonies, and dust was therefore blown into any tunnels in active use in the upper structure of buildings as a supplement to treatment of the soil when accessible with DDT (and later pentachlorophenol). *Reticulitermes* (*Leucotermes*) *speratus* (Kolbe) was found in faultily constructed wooden buildings in Japan as far north as Sendai. In Kyushu, feeding by termites that had built a nest in soil in a roof-garden caused severe structural damage to celotex-type insulation used as sub-flooring on the seventh floor of a ferro-concrete building.

In Manila, *Heterobostrychus aequalis* (Waterh.) and *Dinoderus minutus* (F.), infesting a rattan and bamboo building, and *Herculia nigrivitta* (Wlk.) infesting the Nipa-palm thatch, were controlled by three weekly applications of a spray of 5 per cent. DDT in kerosene applied to allow heavy rundown into the crevices.

Fumigation with hydrocyanic acid gas gave good control of heavy infestations of *Tribolium confusum* Duv. and other pests in flour in Manila in spite of unsatisfactory conditions. After fumigation, 10 per cent. DDT dust was applied lightly over the surfaces of rice and flour bags, and this was repeated after six weeks. As in Japan, where *Calandra* (*Sitophilus*) *oryzae* (L.) and *T. confusum* were common in flour and rice, the dust prevented any further reinfestation. Ornamental pine trees dying as a result of attack by bark-beetles, notably *Myelophilus piniperda* (L.), were felled and the bark burned. Others showing only slight evidence of attack were sprayed heavily with 5 per cent. DDT as a wettable powder at intervals of about five weeks from April to the end of July, and yellowing or failing branch tips were collected and burned. After treatment for two years, no further damage was seen. Other insects that caused concern included the fall webworm [*Hyphantria cunea* (Dru.)], which had appeared in Japan since the war and was present in parks in Tokyo. These were dusted with BHC.

Chiang (H. C.) & Cutkomp (L. K.). **The Importance of some biological Characteristics of European Corn Borer on Timing of Application of Insecticides.**—*J. econ. Ent.* **46** no. 2 pp. 277–287, 6 refs. Menasha, Wis., 1953.

The efficiency of insecticidal control of the first generation of the European corn borer [*Pyrausta nubilalis* (Hb.)] on field maize in Minnesota is discussed with reference to the current recommendation of applying treatment 10–12

days after the first eggs have hatched if the number of egg-masses reaches 50 per 100 plants on any day during the oviposition period. Most of the data on which the analysis is based were obtained from observations at Waseca during 1948–51 on the seasonal progress of egg deposition and hatching, the distribution of larvae on the plants and larval survival on plants of different heights. Observations on natural infestations showed that hatching extended over a longer period and that larvae became established in the stems later in years with low average temperatures early in the season than in normal years, and that the condition of the growing plant, depending on sowing date, also had some effect. When plants of two varieties were infested artificially, larval survival increased with an increase in plant height, the relation being much closer in one variety than in the other.

On the assumption that an insecticide will kill all the larvae that come into contact with it for eight days after a single application timed according to the recommendation, it is calculated that as many as 27 per cent. of the larvae would have hatched after the dissipation of the insecticide in a cool season (1950) and that a considerable proportion would have entered the stalks before treatment in a warm one. Control is thus likely to be low in either unusually warm or unusually cold seasons. Furthermore, the insecticide chiefly affects larvae hatching early in the season, when the plants are small and the chance of survival less than later. Estimates of the probable effect of treatments applied on the 6th–16th day after hatching began in 1949 and 1950, based on the period of hatching, larval establishment in the stems and differential larval mortality, showed that the relative advantages and disadvantages of early and late applications depend mainly on weather and the degree of infestation.

Two tests were made on sweet maize to determine the maximum efficiency of insecticides under field conditions. In the first, in which each treated and untreated plant was artificially infested with egg-masses two days before treatment, immediately after it and 2, 4 and 6 days later, DDT at 1·5 lb. per acre in wettable-powder and emulsion sprays, wettable *Ryania* at 6 lb., *Ryania* at 1·25 lb. with 0·167 lb. N-octylsulphoxide of isosafrole and wettable parathion at 0·45 lb. reduced the numbers of larvae on the whole plant seven weeks after treatment by 82, 77, 34, 70 and 69 per cent., respectively. The control given by wettable DDT exceeded that obtained by other workers with lower initial natural infestations, possibly because in the test described, the egg-masses were concentrated uniformly on the plants within ten days instead of being deposited over at least 20 days, as would be usual under natural conditions. In the second test, which was designed to ascertain duration of effectiveness, the plants were artificially infested with egg-masses 1–10 days after spraying with 1·5 lb. 75 per cent. wettable DDT, 6 lb. wettable *Ryania* or 0·45 lb. wettable parathion per acre. Examination of borer infestation eight weeks after treatment showed that parathion was more effective than DDT initially but less so after three days. Both initial effectiveness and period of effectiveness varied with plant variety as much as with insecticide, but for all materials, control dropped from about 80–100 per cent. on the day after treatment to 10 per cent. or less on the eighth. The loss in effectiveness is due to the growth of the plant and the tendency of the larvae to move towards newly exposed leaves, as well as to decomposition of the insecticides.

It is concluded that applications made a fixed number of days after hatching begins cannot give consistently good control under all weather conditions, and that a more flexible system, depending on biological events that adjust themselves to changes in weather, is desirable. It is unlikely that a more toxic insecticide would by itself improve control.

Sakimura (K.). *Parthenothrips dracaenae*, **a Non-vector of the Spotted Wilt Virus.**—*J. econ. Ent.* **46** no. 2 p. 287, 1 ref. Menasha, Wis., 1953.

Parthenothrips dracaenae (Heeger), which is injurious in greenhouses in Europe [*cf. R.A.E.*, A **18** 435] and the United States [*cf.* **13** 382], was recently discovered on Oahu, Hawaii. Since several thrips are known to transmit the virus of spotted wilt in other parts of the world and it is present in Hawaii, the ability of *P. dracaenae* to serve as a vector was investigated in April–October 1952. The thrips was reared on *Emilia sonchifolia*, a standard source of the virus, and the combined egg and larval stages lasted 30–35 days and the complete life-cycle 50 days at mean monthly temperatures of 73–78·5°F. Thrips that hatched and were allowed to develop on heavily infected leaves of *Emilia* were transferred to healthy plants as full-grown nymphs, prepupae or pupae. Observation of 90 of these plants for 30 days or more revealed no transmission of the virus, though 840 insects had been transferred to them, and it is concluded that *P. dracaenae* is not a vector.

Metcalf (R. L.) & March (R. B.). **The Isomerization of Organic Thionophosphate Insecticides.**—*J. econ. Ent.* **46** no. 2 pp. 288–294, 1 graph, 17 refs. Menasha, Wis., 1953.

The thionophosphate insecticides dealt with in the investigations described included parathion, methyl-parathion and isopropyl-parathion (O,O-diethyl, O,O-dimethyl and O,O-diisopropyl O-p-nitrophenyl thionophosphate), malathon (O,O-dimethyl S-(1,2-dicarbethoxyethyl) dithiophosphate) and EPN (ethyl p-nitrophenyl thionobenzenephosphonate), and their isomerisation was by exchange of the double-bonded sulphur on the phosphorus atom for double-bonded oxygen [*cf. R.A.E.*, A **40** 327].

Early studies on the mode of action of parathion in mammals and insects indicated that it was a strong inhibitor of cholinesterase *in vivo* and inactivated about 50 per cent. of various cholinesterases at concentrations of the order of 10^{-6} M. *in vitro* [*cf.* **38** 317], but more recent work has shown that very highly purified parathion is a feeble inhibitor of cholinesterases *in vitro* and that impure preparations are much more active, owing to the presence of traces of the parathion isomeride, O,S-diethyl O-p-nitrophenyl thiophosphate, which is a very active anticholinesterase. Investigations were therefore carried out with the various materials to determine the effect of isomerisation on their mode of action and toxicity to insects and mammals.

Highly purified samples were tested for toxicity to house-flies [*Musca domestica* L.] by topical application, for oral toxicity to white mice by administration in propylene-glycol solutions and for inhibition of fly-brain and mouse-brain cholinesterases by the manometric method [*cf.* **39** 174], before and after isomerisation by heating to a temperature of 150°C. in sealed tubes for varying periods. The isomerised products contained only small amounts of thiono-sulphur, and were shown by paper chromatography to consist of mixtures of compounds, of which the S-alkyl isomerides were the chief constituents. The degree of isomerisation, as measured by reduction in thiono-sulphur content, was 83 per cent. in 3·5 hours and 91 per cent. in 6·5 hours for methyl-parathion, 80 and 94 per cent. in 24 hours for parathion in two tests, about 90 per cent. in 24 hours for malathon and 20 per cent. in 24 hours for EPN. Isomerised samples of methyl-parathion, parathion, malathon, EPN and isopropyl-parathion were all more effective as inhibitors of fly-brain cholinesterase and less toxic to flies than the

untreated compounds [*cf.* also **39** 200–201], and those of methyl-parathion and parathion more active inhibitors of mouse-brain cholinesterase and less toxic to mice than the untreated compounds; the other materials were not tested with mice. Tests with standard sodium-hydroxide solutions at 37°C. to determine whether the lower toxicity of the isomerides might be due to increased susceptibility to hydrolysis showed that the isomeride of parathion was hydrolised nearly 300 times as rapidly as parathion. That of methyl-parathion gave less clear-cut results, 20 per cent. hydrolysis occurring in ten minutes, after which the process almost completely ceased.

Since isomerisation of the thionophosphates greatly increased their effectiveness as anticholinesterases, a graph relating the percentage cholinesterase inhibition to the concentration of nearly pure isomeride can be used to measure extremely small amounts of isomeride; such a graph is given for 91 per cent. isomerised parathion.

In further studies of isomerisation, a solution of 1×10^{-2} M. purified methyl-parathion in ethanol was isomerised by heating at 100°C. for 0·5–4 hours, the amount of isomeride formed being directly proportional to the period of heating and reaching about 30 per cent. in four hours, but not at all by heating at 50°C. for the same period. Slight isomerisation occurred on exposure to ultraviolet irradiation for 24–72 hours at 19°C. Isomerisation also took place when the solution was left standing in the laboratory for five months, the percentage inhibition of fly-brain cholinesterase at a dilution of $3{\cdot}3 \times 10^{-5}$ M. increasing from 5 to 94.

A knowledge of the isomerisation of thiophosphate insecticides is important, since the presence of the isomerides may give very misleading values as to anticholinesterase activity, hydrolysis rates and toxicity, and their formation affect the decomposition of residues on plants. Samples of technical parathion were shown to contain 5–20 per cent. S-ethyl isomeride, and a sample of technical O,O-diethyl O-2-(ethylmercapto)ethyl thionophosphate (the active ingredient of Systox) contained only 52 per cent. of the theoretical amount of thiono-sulphur, indicating the presence of nearly equal amounts of the thionophosphate and the isomeride, O,O-diethyl S-2-(ethylmercapto)ethyl thiophosphate.

Dowden (P. B.), Jaynes (H. A.) & Carolin (V. M.). **The Role of Birds in a Spruce Budworm Outbreak in Maine.**—*J. econ. Ent.* **46** no. 2 pp. 307–312, 7 refs. Menasha, Wis., 1953.

Investigations were attempted in 1949–50 on the significance of insectivorous birds in the control of *Choristoneura fumiferana* (Clem.) in forests in northern Maine, where this budworm appeared to be increasing to outbreak proportions. In one of three selected areas of typical second-growth forest, consisting mainly of balsam fir [*Abies balsamea*] and black spruce [*Picea mariana*], as many birds as possible were shot in June–July, during the period in which they feed on the budworm, and in the other two they were left undisturbed. Estimates of budworm populations before and directly after shooting failed to provide a reliable quantitative measure of the effect of the birds, but the reductions in population between the full-grown larval and late pupal stages were far greater where birds were unmolested than where they were shot [*cf. R.A.E.*, A **39** 234].

Analysis of the stomach contents of 826 birds collected in the experimental areas showed that 21 per cent. in 1949 and 40 per cent. in 1950 consisted of *C. fumiferana*. Substantial reductions in budworm population may also have been caused by red squirrels, examination of the stomach contents of 25 of which, collected between 13th June and 10th July 1950, showed that they were feeding almost entirely on insects and that 51 per

cent. of the total food consisted of *C. fumiferana*. Limited data from small caged and uncaged trees indicated that birds destroyed about 150 budworms per tree over a period of four weeks, which would be of little economic significance in heavy outbreaks, but of some importance in light infestations.

ACREE jr. (F.). **The Isolation of Gyptol, the Sex Attractant of the Female Gypsy Moth.**—*J. econ. Ent.* **46** no. 2 pp. 313–315, 9 refs. Menasha, Wis., 1953.

An account is given of the preliminary results of further investigations on the isolation and properties of the sex attractant present in benzene extractives of the abdominal tips clipped from virgin females of *Lymantria* (*Porthetria*) *dispar* (L.) [*cf. R.A.E.*, A **33** 239], and the name gyptol is proposed for it.

DECKER (G. C.), BIGGER (J. H.) & WEINMAN (C. J.). **Spraying the Margins of Fields as a Substitute for Barrier Construction in Chinch Bug Control.**—*J. econ. Ent.* **46** no. 2 pp. 316–320, 1 fig., 6 refs. Menasha, Wis., 1953.

In further tests by the dust-barrier technique [*cf. R.A.E.*, A **38** 120, etc.] in Illinois of insecticides that might be suitable for application to the margins of fields to prevent migration by *Blissus leucopterus* (Say), 0·1–1 per cent. parathion, dieldrin or endrin [*cf.* **41** 268, note] and 0·125–2 per cent. Dilan [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] or DDD (TDE) were investigated. Parathion gave complete mortality in 2–4 days, dieldrin 90–100 per cent. in 3–4 days and endrin 78·9–99·4 per cent. in four days; Dilan was less effective and DDD useless.

In the course of a light migration from wheat to maize in 1949, when the first few rows of maize were already moderately infested, sprays were applied to 10 ft. of the margin of the wheat field and the first seven rows of maize. The base and undersides of the lower leaves of the maize, the spaces between the rows and between the crops and the soil and bases of the wheat plants were sprayed, and daily observations made for ten days, after which all migration ceased. Chlordane at 1 lb., aldrin and dieldrin at 0·5 lb., γ BHC as lindane at 0·3 lb. and parathion at 0·25 lb. in 20–25 U.S. gals. spray per acre all gave excellent initial kill, but only dieldrin maintained control throughout the period; there were no signs of repellent effect.

In 1951, moderately infested plots of wheat in a field adjacent to maize were sprayed with 1 lb. chlordane, 0·25 lb. γ BHC or dieldrin or 0·5 lb. endrin in 10 U.S. gals. spray per acre on 25th June. Rain fell on 27th June, eliminating about 75 per cent. of the bugs, and on 8th July, terminating the infestation. No active insects were seen throughout the experiment on plots treated with dieldrin or endrin, γ BHC gave good immediate control but was ineffective after four days, and chlordane was useless. In another moderately infested field of wheat in which migration to adjacent maize began on 15th July, spraying a plot with 0·5 lb. dieldrin in 10 U.S. gals. per acre on 16th July prevented migration across it for a week and was still fairly effective after 20 days, whereas plots treated with 1·5 lb. chlordane or 0·5 lb. parathion per acre were invaded on the first and second day after treatment, respectively, and overrun on the fourth and seventh days. In both tests, several rows of maize and a strip of wheat where the crops adjoined were sprayed with dieldrin or endrin, and there was no further invasion of the maize.

In 1952, light to moderate infestations in wheat and maize were sprayed with dieldrin at 0·25–0·5 lb. per acre by ground equipment or at 0·5 lb. from an aeroplane, which gave immediate kill and prevented reinfestation, in spite of attempted migration from untreated grain for 7–28 days. Parathion and endrin gave similar results in small-plot tests to those obtained in 1951, and it is concluded that of the materials tested, only dieldrin and endrin show the degree of persistence required.

Samples of wheat and oats sprayed with 8 lb. dieldrin per acre and cut and threshed within 1–3 hours showed residues of 3·6–9·2 parts per million, similar samples taken immediately after treatment with 0·5 lb. per acre 0·2–0·53 p.p.m., and samples taken at harvest from field margins sprayed with 0·5 lb. per acre 3–7 days earlier less than 0·1 p.p.m.; residues on oats were about twice those on wheat. Ears and lower leaves of maize that were present at the time of treatment in late June or early July and were tested in October showed no residue and 0·12–1·8 p.p.m., respectively. Such residues are of little importance, since leaves present at the time of treatment form only a small proportion of the plant at harvest and only a few of the plants in a field are treated, but it may be advisable not to feed livestock with sprayed foliage.

Davis (A. C.) & Swenson (K. G.). **Evaluation of Insecticides for Pea Insect Control.**—*J. econ. Ent.* **46** no. 2 pp. 321–323, 4 refs. Menasha, Wis., 1953.

Macrosiphum pisum Harr. (*pisi* (Kalt.)) and *Bruchus pisorum* (L.) are the most important insect pests of peas in western New York, and various new insecticides were evaluated for their control in 1951–52. They were applied in emulsion sprays at 25 U.S. gals. per acre in 1951 and 15 U.S. gals. in 1952 with a tractor-mounted low-volume sprayer.

Tests against the Aphid were carried out on peas in 1951 and on lucerne in 1952. Of the materials applied in one or both years, 1 U.S. pint 25 per cent. parathion or 20 per cent. TEPP [tetraethyl pyrophosphate] 0·8 U.S. pint 50 per cent. malathon, 1 U.S. pint Metacide [6·2 per cent. parathion, 24·5 per cent. methyl-parathion and 2·7 per cent. related organic phosphates], 0·5 U.S. pint Systox [42 per cent. O,O-diethyl O-2-(ethylmercapto)ethyl thiophosphate (demeton)] and 1 U.S. quart 25 per cent. DDT per acre gave excellent control, whereas 1 U.S. quart 25 per cent. methoxy-DDT (methoxychlor), Dilan [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] or Q-137 [1,1-dichloro-2,2-bis(p-ethylphenyl)ethane (ethyl-DDD)] and 1 U.S. pint 23 per cent. aldrin showed no promise. Tetra-n-propyl dithionopyrophosphate (NPD) and 1-isopropyl-3-methyl-pyrazolyl(5) dimethyl carbamate (Geigy 340) were tested for the first time in 1952; the former at 0·5 U.S. pint 85 per cent. concentrate per acre appeared to be slow in action, but was as effective as the other phosphates after four days, but the latter, at 1 U.S. pint 25 per cent. concentrate, was less effective than the phosphates or DDT.

Against the Bruchid, all the materials tested gave better control in 1952, when they were applied three times at intervals of 4–5 days, than in 1951, when they were applied twice with an interval of six days. In 1951, 1 U.S. pint Metacide and 1 U.S. quart 25 per cent. Dilan per acre gave 88 and 75 per cent reduction in infested peas and 1 U.S. pint 20 per cent. TEPP and 1 U.S. quart 25 per cent. Q-137 no control, and these materials were not tested further. Sprays of 1 U.S. quart 50 per cent. malathon, 25 per cent. DDT or 25 per cent. methoxy-DDT or 1 U.S. pint 25 per cent. parathion per acre gave 88, 38, 0 and 68 per cent reduction. In 1952, 1 U.S. pint 25 per cent. parathion, 0·8 U.S. pint 50 per cent. malathon, 1 U.S. quart

25 per cent. DDT or methoxy-DDT or 23 per cent. aldrin and 0·5 U.S. pint 85 per cent. NPD per acre gave 99·5, 83·9, 89·6, 70·1, 92·7 and 77·1 per cent. reduction, and 1 U.S. pint 25 per cent. Geigy 340 was ineffective. In the same test a dust of 1 per cent. rotenone at 35–40 lb. per acre, which was formerly much used on peas, gave 89·1 per cent. reduction. Since the peas grown in western New York are used for canning and the vines are fed to livestock, both DDT and aldrin, which leave persistent residues, are undesirable. NPD is considered worthy of further investigation.

Reiser (R.), Chadbourne (D. S.), Kuiken (K. A.), Rainwater (C. F.) & Ivy (E. E.). **Variations in Lipid Content of the Boll Weevil and seasonal Variation in its Resistance to Insecticides.**—*J. econ. Ent.* **46** no. 2 pp. 337–340, 3 graphs, 8 refs. Menasha, Wis., 1953.

Anthonomus grandis Boh. has been shown in Texas to become progressively more difficult to control as the cotton-growing season advances [*cf. R.A.E.*, A **40** 113], and the type of food on which it develops has been found partly responsible for this [*cf.* **40** 334]. Attempts were therefore made to determine whether a biochemical change in the insect might be correlated with the month of the year or with changing nutritional status.

As chlorinated hydrocarbons are known to be accumulated in animal fat [*cf.* **37** 425, etc.], the possibility was tested that resistance late in the season might be due to storage of the poison in an increased amount of body fat. Analysis of samples of weevils collected in the field in June–November in 1950 and 1951 showed a steadily increasing fat content as the season progressed, corresponding rather closely with the reported increase in resistance to toxaphene. However, there was a similar correlation between fat content and resistance to calcium arsenate [*cf.* **40** 113], and analysis of weevils treated with toxaphene, dieldrin, EPN [O-ethyl O-p-nitrophenyl benzenethiophosphonate] and methyl-parathion or left untreated showed that in all cases the survivors were fatter and larger and contained more moisture than those that died. Fat, therefore, appears to be a non-specific protection aiding survival in any adverse environment. Analysis of last-instar larvae of *Heliothis armigera* (Hb.), *Estigmene acraea* (Dru.), *Laphygma frugiperda* (S. & A.), *Loxostege similalis* (Gn.), *Prodenia ornithogalli* Gn. and *Alabama argillacea* (Hb.) showed no correlation between body fat and resistance to toxaphene.

The increase in fat in the weevils as the season progresses may be due to the increase in the proportion of older weevils and decrease in the proportion of overwintered adults in the population or to the different nutritional environment early and late in the season. It is suggested that weevils that feed on cotton bolls receive more and better nourishment than those that feed on squares, and that this accounts for their larger size, increased fat content and increased resistance to insecticides.

Mistric jr. (W. J.) & Gaines (J. C.). **Effect of Wind and other Factors on the Toxicity of certain Insecticides.**—*J. econ. Ent.* **46** no. 2 pp. 341–349, 4 refs. Menasha, Wis., 1953.

Further investigations on the effect of climatic factors on the toxicity of insecticides to insects that attack cotton were carried out at College Station, Texas, in 1952 [*cf. R.A.E.*, A **40** 334, etc.]. The materials tested included endrin and isodrin [**41** 268, note], and they were all applied as sprays prepared by diluting emulsion concentrates with water. The following is based on the authors' summary of the work. Comparison of

the results of laboratory and field cage tests with adults of *Anthonomus grandis* Boh. showed that 2–3 times as much of the various insecticides was required to kill a comparable proportion of the weevils in the field as in the laboratory. This ratio was lower than in 1951, when temperatures were higher and relative humidities lower. High temperatures, wide ranges in relative humidity, sunlight, dew and wind were all important in reducing toxicity in the field. When exposed to normal conditions, dieldrin retained its toxicity longest, and toxaphene, EPN [O-ethyl O-p-nitrophenyl benzenethiophosphonate] and endrin for longer than γ BHC, aldrin, heptachlor or methyl-parathion; the toxicity of γ BHC and methyl-parathion was greatly reduced by the various factors, and aldrin and heptachlor showed appreciable losses even when protected from normal climatic conditions in the laboratory. It was also necessary to use 2–3 times as much insecticide to give complete kill of the weevils late in the season as early in it; since the climatic conditions did not vary sufficiently to account for such a difference, it is assumed to be due to changes in the physiology of the insects [*cf.* preceding abstract]. The application of 0·5 inch simulated rain caused an appreciable reduction in the toxicity of heptachlor, but not in that of toxaphene, EPN, methyl-parathion or endrin, when made soon after spraying, and caused noticeable reductions in the toxicity of toxaphene and dieldrin and destroyed that of aldrin when made 24 hours after it. Aldrin and heptachlor showed greater reductions in toxicity due to the effect of rain than any other insecticides tested; either they were washed off the plants or the rain caused decomposition of the compounds. The application of simulated dew 24 hours after spraying caused little or no reduction in the toxicity of toxaphene or dieldrin. In general, a temperature of 116°F. caused greater reductions in the toxicity of toxaphene, EPN, aldrin, dieldrin and heptachlor than one of 68°F., and aldrin and heptachlor were more affected by high temperature than the other materials. Exposure of the treated plants to simulated wind of 3·8–4·9 miles per hour for 24 hours did not greatly reduce the toxicity of toxaphene or dieldrin.

In laboratory tests against larvae of *Alabama argillacea* (Hb.), simulated wind of 3·7–12·4 m.p.h. reduced the toxicity of toxaphene, methyl-parathion, endrin, dieldrin, γ BHC, aldrin and malathon, and 0·5 inch simulated rain soon after treatment caused little or no reduction in the toxicity of toxaphene, EPN, parathion, endrin or isodrin, but greatly reduced that of methyl-parathion and malathon. Against *Estigmene acraea* (Dru.), the simulated rain greatly reduced the toxicity of heptachlor, but had little effect on that of toxaphene or an experimental mixture of chlorinated terpene isomers.

It is concluded that some insecticides lose toxicity rapidly even under normal climatic conditions, and extremes tend to accelerate these losses; others retain toxicity over longer periods, and only the greatest climatic extremes reduce their toxicity.

Mistric jr. (W. J.) & Gaines (J. C.). **The Toxicity of certain Insecticides to the overwintered Boll Weevil.**—*J. econ. Ent.* **46** no. 2 pp. 350–352, 3 refs. Menasha, Wis., 1953.

Investigations were made at College Station in 1952 to assess the effectiveness against the overwintered adults of the boll weevil [*Anthonomus grandis* Boh.] of the organic insecticides currently recommended for its control on cotton in Texas. All materials were applied as emulsion sprays and the weevils were caged on the plants immediately after spraying. In the laboratory, at an average daily temperature of 77–87°F. and relative humidity of 52–85 per cent., 1·5 lb. toxaphene, 0·25 lb. aldrin or dieldrin

and 0·2 lb. γ BHC in 5 U.S. gals. spray per acre gave average mortalities of at least 75 per cent., but 0·25 lb. heptachlor gave an average of only 45·8. In field tests with the same amounts of insecticide in 7·5 U.S. gals. spray per acre, only dieldrin was effective, giving an average of 91·5 per cent. mortality; the toxicity of toxaphene and aldrin was low, and heptachlor and BHC were ineffective. Weather conditions were normal during the experiment, with average daily temperatures of 74–95°F. and relative humidities of 40–87 per cent., heavy dews every morning, cloudy skies and an average daily wind movement of 6·3 miles per hour, and these apparently favoured the weevil and reduced the effect of the insecticides [*cf.* preceding abstract]. It is generally considered that the overwintered weevils can be satisfactorily controlled early in the season with relatively low dosages of organic insecticides, owing to their decreased resistance [*cf. loc. cit.*, etc.], but the results of these tests indicate that higher dosages may sometimes be required.

KERR jr. (T. W.). **Control of Rhododendron Whitefly, Woolly Larch Aphid, Rose Scale and Southern Red Mite.**—*J. econ. Ent.* **46** no. 2 pp. 353–355, 7 refs. Menasha, Wis., 1953.

Investigations on the control of pests attacking ornamental trees and shrubs in Rhode Island [*cf. R.A.E.*, A **40** 227, etc.] were continued in 1952. Spray quantities are given per 100 U.S. gals., and 4 oz. Triton B-1956 (a modified phthalic glycerol alkyd resin) was added as a wetter, spreader and adhesive to all but petroleum-oil sprays.

Dialeurodes chittendeni Laing is an occasional pest of rhododendrons. Adults were present from about 27th May to 24th June, and hatching of the eggs began on 23rd June and was almost complete by 7th July. The experimental bushes received two spray applications, on 5th and 23rd June, and some a third on 7th July, and counts on 16th–22nd October, when most of the larvae were in the third instar, showed that two applications of 1·33 and 0·67 lb. 75 per cent. wettable DDT, 1 and 0·5 lb. 25 per cent. wettable γ BHC as lindane and 1 U.S. pint nicotine sulphate gave 97·8, 99·4, 89·3, 81·9 and 91·9 per cent. control, respectively, as compared with no treatment, and three applications of the same sprays 99·9, 99·8, 97·5, 49·9 and 97·9 per cent. DDT and BHC acted mainly by preventing oviposition, but also killed the newly hatched larvae. Nicotine sulphate prevented some oviposition, but acted chiefly as an ovicide.

Aulacaspis rosae (Bch.) is present locally in most seasons, mainly on *Rosa rugosa*. In 1952, the overwintered scales produced eggs from 22nd May until 16th July, and nymphs of the first generation were observed from 12th June. Sprays were applied in June–July, and counts of females on 15th–18th August showed that 1 U.S. quart nicotine sulphate was more effective than 2·67 lb. 75 per cent. wettable DDT, but gave only 83·7 per cent. control even when applied three times.

Chermes strobilobius Kalt. has been a serious pest of *Larix laricina* in Rhode Island for several years. In 1952, eggs were first observed on 14th April and hatching on 2nd May. Counts on 29th–30th May showed that treatment with 3 U.S. gals. petroleum oil alone or 2 U.S. gals. petroleum oil with 1 U.S. pint nicotine sulphate on 11th April gave complete control, whereas 1 or 0·5 lb. 25 per cent. wettable γ BHC or 1 U.S. pint nicotine sulphate, applied on 27th May, gave only 91·9, 89·4 and 95·9 per cent., respectively. The oil treatments caused slight injury to the newly developing foliage.

Repeated spraying of American holly (*Ilex opaca*) with DDT for the control of *Phytomyza ilicicola* Lw. (*ilicis*, auct.) [*cf.* **38** 428] resulted in

an increase in populations of *Paratetranychus ilicis* (McG.) on the leaves, and in tests in 1952, when 1·33 lb. 75 per cent. wettable DDT was applied against the leaf-miner on 23rd May and 2nd June, 1·5 lb. 15 per cent. wettable 2-chloroethyl 2-(p-tert-butylphenoxy)-1-methylethyl sulphite (Aramite) or 1 lb. 50 per cent. wettable p-chlorophenyl p-chlorobenzenesulphonate (Ovotran) was added to the first spray or both on some plants in an attempt to prevent this. The numbers of mites per leaf on 2nd July and 30th September, respectively, were 9·4 and 1·24 after two applications of DDT alone; 0·24 and 50·44 when Aramite was added to the first spray and 0·12 and 0·95 when it was added to both; 0·04 and 22·35 after the addition of Ovotran to the first spray and 0·02 and 3·15 after its addition to both; and 3·9 and 0·76 for no treatment. It is therefore concluded that the acaricides were effective when used in both sprays but did not prevent an increase in the mite population when included in the first spray only. Ovotran caused some damage to the foliage.

Holbrook (R. F.). **Gypsy Moth Sex Attractant from Europe for Use in Trapping Program.**—*J. econ. Ent.* **46** no. 2 pp. 355–357. Menasha, Wis., 1953.

The annual surveys of infestation by *Lymantria (Porthetria) dispar* (L.) in the north-eastern United States necessitate the collection of large numbers of pupae of the moth to maintain the supply of the sex attractant used in the traps set out [*cf. R.A.E.*, A **41** 281, etc.]. These used to be obtained from the Cape Cod area of Massachusetts, but the moth was eliminated from there by the aerial spray campaigns of 1949 and 1950, and no comparable source was available. Collection in Europe was therefore begun in 1951. No large areas of infestation were known in France and none was found in Spain or Italy in that year, but a heavily infested area was found in Portugal, where the main food-plant of the moth is cork oak [*Quercus suber*] [*cf.* **41** 333]. Large numbers of pupae were collected there in 1951 and 1952, the females allowed to emerge in the laboratory and the extract prepared from the abdominal tips. In the course of 1952, extensive outbreaks of the moth were reported from Spain, Morocco and Yugoslavia.

Schread (J. C.). **Isodrin, Endrin and Lindane for Grub Control in Turf.** —*J. econ. Ent.* **46** no. 2 pp. 357–359, 3 refs. Menasha, Wis., 1953.

Isodrin and endrin [*cf. R.A.E.*, A **41** 268, note] were tested in Connecticut in 1951 and 1952 for the control of mixed populations of larvae of *Popillia japonica* Newm. and *Anomala orientalis* Waterh. in turf. In 1951, dusts of 1 per cent. isodrin and endrin applied on 29th and 20th August, respectively, when the larvae were in the first and early second instars, at 0·5, 1 and 2 lb. actual toxicant in 250 lb. fertiliser per acre reduced the larvae in most of the plots by 2nd October and practically eliminated them in all plots by 14th November. In 1952, 18·5 per cent. emulsion concentrates of isodrin and endrin applied to the soil at rates of 0·5 and 2 lb. technical insecticide in 400 U.S. gals. water per acre during a rainstorm on 25th April, when most of the larvae were in the third instar, eliminated the larvae by 29th May, and a 12·9 per cent. emulsion concentrate of γ BHC as lindane, similarly applied, practically eliminated them by the same date.

Soil temperatures were higher in August and September 1951 than in April and May 1952, but only 1·26 ins. rain fell between 20th August and 1st October and 8·3 ins. between 1st October and 14th November, after

most of the larvae had begun to move downwards to hibernate, as compared with 7·15 ins. between 25th April and 29th May, and it is considered that rainfall had more effect on speed of action than soil temperature or the size of the larvae.

In September 1952, no larvae were found in any of the plots treated in either 1951 or 1952, whereas there were mixed populations of 8·9 per sq. ft. in untreated turf. There was no apparent difference in rate of kill between the two species, and isodrin or endrin appeared to be just as effective at 0·5 as at 2 lb. per acre.

Eden (W. G.). **DDT for Earworm Control in Sweet Corn.**—*J. econ. Ent.* **46** no. 2 pp. 359–360, 7 refs. Menasha, Wis., 1953.

Three experiments were carried out in Alabama in 1952 on the use of DDT against *Heliothis armigera* (Hb.) on sweet maize. In the first, in which aeroplanes were compared with ground equipment, treatments were applied five times at intervals of three days, beginning on 26th May, when 10 per cent. of the stalks were in silk, and all gave significant control. Aeroplane applications of 4 lb. DDT in 4 U.S. gals. spray per acre at particle sizes of 50 and 300 microns gave about 30 per cent. uninfested ears, as compared with 5·5 per cent. in the controls, with no difference between them, and were significantly more effective than aeroplane applications of 10 per cent. DDT dust at 40 lb. per acre. When applied in sprays with ground equipment, DDT at the rate of 2 lb. per acre was as effective in the form of a commercial 25 per cent. emulsion concentrate as in a mineral-oil emulsion and gave about 73 per cent. uninfested ears. Temperatures were extremely high and humidity low towards the end of the experiment, and the mineral-oil spray caused slight scorching of the foliage. In the second, there was no difference in control when a spray of 2 lb. DDT and 10·8 lb. mineral oil (approximately 1·5 U.S. gals.) in 20 U.S. gals. spray per acre was applied 4–5 times at three-day intervals beginning just before silking or at 10 per cent. silking, all treatments increasing the percentage of uninfested ears from 22 to 90–93. There was some scorching on plants sprayed five times. In the third, in which the commercial concentrate was used, DDT was tested at 1, 2 and 3 lb. with 1·5 U.S. gals. oil per acre and at 2 lb. with 0, 1·5 and 2·5 U.S. gals. oil per acre. The sprays were applied four times at three-day intervals, beginning at 10 per cent. silking. All treatments gave significant control, increasing the percentage of uninfested ears from 18 to 72·5–90. With 1·5 U.S. gals. mineral oil, 2 lb. DDT was significantly better than 1 lb. but not significantly worse than 3 lb. With DDT at 2 lb., varying the amount of mineral oil had no effect. DDT alone did not damage the foliage, but 1·5 U.S. gals. mineral oil caused slight and 2·5 U.S. gals. severe injury. None of the sprays affected the degree to which the ears were filled.

Frick (K. E.) & Simkover (H. G.). **Insecticides for killing Cherry Fruit Fly Maggots within the Fruit.**—*J. econ. Ent.* **46** no. 2 pp. 361–362, 2 refs. Menasha, Wis., 1953.

Both parathion and EPN [O-ethyl O-p-nitrophenyl benzenethiophosphonate] have been reported to kill larvae of *Rhagoletis cingulata* (Lw.) in cherry fruits [*cf. R.A.E.*, A **40** 91], and the experiments described were carried out in Washington State to determine to what extent mortality depends on the presence of the breathing holes that are made by the larvae through the cherry skin 1–5 days before they leave the fruit. In 1949,

examination on 5th–8th July of heavily infested cherries from two trees sprayed with 4 lb. BHC (6 per cent. γ isomer) per 100 U.S. gals. on 5th July showed that no larvae were killed in fruits that lacked breathing holes; only 8–14 per cent. mortality was obtained in all, and it is concluded that BHC at economic rates of application is of limited value for the purpose. In laboratory tests in 1951, three samples of ten cherries showing breathing holes were each sprayed with 5 cc. wettable-powder suspension, so that each fruit was thoroughly wet, and hung over a layer of soil. Examination of cherries and soil after 24 hours showed that the percentage mortalities of the larvae were 42, 20 and 67 for 10 lb. BHC (10 per cent. γ isomer), 2 lb. 25 per cent. malathon and 1 lb. 25 per cent. parathion per 100 U.S. gals., as compared with none for water alone.

In 1952, applications on 16th July of 1 U.S. pint Systox containing 32·1 per cent. active ingredient [O,O-diethyl O-2-(ethylmercapto)ethyl thiophosphate (demeton)] or 1 lb. 25 per cent. wettable parathion per 100 U.S. gals. or no treatment to trees on which many of the fruits had breathing holes and most still contained larvae resulted in 46, 23 and 0 per cent. mortality one day after spraying and in 61, 70 and 5 per cent. in fruits with breathing holes and 86, 81 and 8 per cent. in those without them five days after spraying. Cherries with breathing holes taken from these trees one day after treatment and kept over soil gave rise to 24, 12 and 90 pupae per 100 fruits, and cherries with or without breathing holes taken five days after treatment, to 2, 1 and 37. In a field test of parathion as a post-harvest spray, cherry trees bearing heavily infested unpicked fruits were sprayed from one side with 1 lb. 25 per cent. wettable parathion per 100 U.S. gals. on 1st August. Examination of infested fruits on four sample trees one week later showed 64 per cent. larval mortality on one growing where wind interfered with spraying and 94–98 per cent. on the others, which were in sheltered positions. Mortality was as high in fruits without breathing holes as in those with them, so that this treatment gives very effective post-harvest control.

As Systox and parathion cause heavy mortality even in the absence of breathing holes, they may be absorbed by the fruit; they possibly penetrate the skin and then act as fumigants in the tunnels in the flesh. BHC apparently kills by fumigation and contact, as it does not affect larvae in fruits without breathing holes.

Brower (A. E.). **Forest Insect Survey of Maine.**—*J. econ. Ent.* **46** no. 2 pp. 363–364. Menasha, Wis., 1953.

The objects of the Forest Insect Survey of Maine, which was instituted in 1921, and the methods used by the staff in collecting, rearing, identifying and recording forest insects and their natural enemies in the State are reviewed.

Lee (R. M.), Langford (G. S.) & Cory (E. N.). **Sap Beetles in Maryland.** —*J. econ. Ent.* **46** no. 2 pp. 366–367. Menasha, Wis., 1953.

Sap beetles, particularly *Carpophilus lugubris* Murr., are increasing in importance on sweet maize in Maryland, where all the ears in a field are sometimes infested, though actual damage is seldom great. Adults and larvae are frequently numerous beneath the husks just before and at harvest, and investigations on their control were begun in 1949. Early surveys indicated a distinct relation between heavy infestation and damage by other insects, particularly the Japanese beetle [*Popillia japonica*

Newm.], the European corn borer [*Pyrausta nubilalis* (Hb.)] and the corn earworm [*Heliothis armigera* (Hb.)] and considerable control of it when DDT was applied against *Popillia*. However, occasional fields were found in which ears not injured by other insects contained sap beetles and in which maize sprayed with DDT was heavily infested.

Further surveys showed that adults frequently entered ears that showed no evidence of being attacked by other insects; the numbers were usually small, but ears in all stages of development contained them. Nevertheless, heavy infestation always seemed to be preceded by injury from other insects, ears so damaged containing up to 50 *Carpophilus* larvae, whereas those with no previous injury rarely contained more than 4–5.

Tests in fields in which *P. japonica* was not a problem indicated that contact with DDT did not kill sap beetles, and laboratory tests in which adults were exposed for 24 hours on cardboard disks that had been dipped in solutions of 3 lb. DDT per 100 U.S. gals. confirmed that DDT was not effective. In similar tests, 2 lb. methoxy-DDT (methoxychlor), DDD (TDE) and toxaphene per 100 U.S. gals. gave 0, 28 and 90 per cent. kill, respectively, and 0·5 lb. aldrin and dieldrin 97 and 66 per cent.; γ BHC as lindane at 0·25 lb. per 100 U.S. gals. killed 93 per cent., 1 lb. EPN (O-ethyl O-p-nitrophenyl benzenethiophosphonate) and NPD (tetra-n-propyl dithionopyrophosphate) per 100 U.S. gals. 80 and 100 per cent., and Metacide [6·2 per cent. parathion, 24·5 per cent. methyl-parathion and 2·7 per cent. related organic phosphates] at 0·4 lb. per 100 U.S. gals. 100 per cent. It is concluded that aldrin, toxaphene, EPN, lindane and Metacide should be tested in the field.

Hough (W. S.). **Influence of Parathion wettable Powder on Effectiveness of DDT.**—*J. econ. Ent.* **46** no. 2 pp. 368–369, 5 refs. Menasha, Wis., 1953.

An account is given of investigations in Virginia in 1948–52 on the initial and residual toxicity to larvae of the codling moth [*Cydia pomonella* (L.)] of deposits from sprays of 12 oz. actual DDT and mixtures of 12 oz. DDT and 1 oz. parathion per 100 U.S. gals. Treatment was begun not later than the second cover spray, and apples were removed one day after the fourth and fifth cover sprays, and at weekly intervals thereafter for four weeks, and exposed to larvae in the insectary. In 1948–51, the materials used were a wettable powder containing 50 per cent. DDT and one containing 25 per cent. parathion, and the addition of parathion increased both the initial toxicity of the deposit and the residual effect after 1–4 weeks, possibly owing to synergism or to a change in the physical state of the DDT mixture, but in 1952, when a 75 per cent. wettable DDT powder, differing in inert ingredients from the 50 per cent. powder, and a 15 per cent. wettable parathion powder were used, the mixture was more effective than DDT alone during the first two weeks after treatment, but less so after 3–4 weeks.

Turner (N.). **Development of Resistance to Rotenone by the Mexican Bean Beetle.**—*J. econ. Ent.* **46** no. 2 pp. 369–370, 1 graph, 8 refs. Menasha, Wis., 1953.

Rotenone dusts and sprays have been used for the control of the Mexican bean beetle [*Epilachna varivestis* Muls.] in Connecticut for nearly 20 years, but were reported in 1952 to be less effective than formerly, and it was feared that the beetle might be developing resistance to this toxicant. Larvae from stocks that had not been exposed to rotenone were not available for comparison, but the results of tests of the comparative toxicity of

rotenone and methoxy-DDT (methoxychlor) in 1952 were compared with similar results obtained in 1945 [*R.A.E.*, A **38** 178], when there was no reason to suspect resistance. As methoxy-DDT is not in common use against *E. varivestis* in Connecticut, it was assumed that the insects would show no specific resistance to it.

The reductions in the numbers of larvae on beans on 1st July, after the application of dusts of 0·125–1 per cent. rotenone as cubé or 0·625–5 per cent. methoxy-DDT on 18th and 24th June, during the hatching period of the first generation, were estimated and plotted against concentrations on log-probit graphs. The results with methoxy-DDT were somewhat variable, but it was found that 2·5–3·5 per cent. methoxy-DDT was equivalent to 0·8 per cent. rotenone at the 95 per cent. level of control, that the curve for rotenone was the steeper, and that the two curves intersected at a concentration of 0·2 per cent. In 1945, 1 per cent. methoxy-DDT was equivalent to 0·5 per cent. rotenone at the 98 per cent. level of control and the curves intersected at about 0·4 per cent. concentration, indicating that the difference in toxicity between the two insecticides was greater in 1952 than in 1945. If the toxicity of rotenone had decreased to any marked extent, because of the development of resistance, the difference might have decreased; nothing is known of possible cross-resistance to rotenone and methoxy-DDT.

Comparison of the published results of experiments in which rotenone dust was applied against the second generation, once as soon as the larvae hatched and again a week later, showed that the concentrations required to give 90 per cent. kill in 1942, 1943, 1945 and 1952 were 0·12, 0·35, 0·27–0·35 and 0·5 per cent., respectively, indicating a general upward trend in the dose required. Detailed data on the populations present in 1942–45 are not available, and some of the changes in dose may be due to variations in population, but in 1952, when the largest dose was required, the population was much smaller than in some earlier years. The difference in dosage required has been substantial enough to justify consideration of other materials for control, but is not necessarily alarming. Rotenone loses its effectiveness within 7–10 days after application in Connecticut and has never been so effective as to eliminate *E. varivestis* from a field. It is therefore unlikely to cause the development of strains or mutants showing immunity.

Wolcott (G. N.). **Stilbene and comparable Materials for Dry-wood Termite Control.**—*J. econ. Ent.* **46** no. 2 pp. 374–375, 5 refs. Menasha, Wis., 1953.

In further tests in Porto Rico of extractives of woods that are resistant to termite attack and chemicals related to them [*cf. R.A.E.*, A **39** 321], samples of the very susceptible *Poinciana (Delonix) regia* that were immersed for ten minutes in 0·01 or 1 per cent. solutions of pinosylvin (3,5-dihydroxystilbene) were initially toxic to *Cryptotermes brevis* (Wlk.) [*cf.* **39** 322], and when no longer toxic, repelled the termites for 565 and 674 days, respectively, while samples dipped in 0·01 per cent. pinosylvin monomethyl ether had still not been attacked after two years. Pinosylvin dimethyl ether and dihydropinosylvin monomethyl ether gave protection for shorter but still considerable periods.

In tests of stilbene itself, samples dipped in 0·01, 0·02–0·1 and 0·2–1 per cent. solutions were not eaten until after nearly a year, about a year and a half, and over two years, respectively, and samples dipped in 0·2 per cent. 2,4,6-trinitrostilbene and 2,4-dichlorostilbene were attacked after 471 days and uneaten after two years, respectively; those dipped in 0·01 per cent.

2,4,2′,4′-tetranitrostilbene and 0·005 per cent. 4,4′-dinitrostilbene and 2,4-dinitro-2′,4′-dichlorostilbene were uneaten after ten months. Azobenzene protected for 98 days at 0·005 per cent. and for at least ten months at 0·05 per cent., and benzalaniline protected for 90 days at 0·005 per cent., but did not increase much in effect with increased concentrations up to 0·1 per cent. However, 2,4-dichlorobenzalaniline gave protection for at least nine months at 0·002 per cent., 2,4-dihydroxybenzalaniline for at least ten months at 0·005 per cent., and other benzalaniline derivatives for periods up to about a year at 0·2–0·5 per cent. All the benzalanilines appeared to be non-toxic.

Samples dipped in 0·05 per cent. taxifolin (3,5,7,3′,4′-pentahydroxyflavonone), from *Pseudotsuga taxifolia*, and ryanodine, from *Ryania speciosa* [*cf.* **39** 322], were uneaten for two years and slightly eaten after four years, respectively, and those dipped in 1 per cent. tectoquinone (*β*-methyl anthraquinone) [*cf.* **38** 200] and 0·5 per cent. chlorophorin, from *Chlorophora excelsa*, were uneaten after seven years and ten months, respectively. Pomiferin, from *Maclura pomifera*, at 0·01–0·05 per cent. protected for almost a year, but derivatives of it were less effective, and chrysin and pinocembrin (5,7-dihydroxyflavone and 5,7-dihydroxyflavonone, respectively), both from *Pinus lambertiana*, and several diphenyl compounds gave relatively poor results at concentrations up to 1–2 per cent.

Frost (S. W.). **Response of Insects to black and white Light.**—*J. econ. Ent.* **46** no. 2 pp. 376–377. Menasha, Wis., 1953.

To obtain information on the reactions of insects to ultraviolet light with wavelengths of 3,000–3,800 ångströms, two light-traps of similar construction were operated in the open in Pennsylvania during the summers of 1951 and 1952. In 1951, a 2-watt ultraviolet lamp with a "black light filter" was compared with 7- and 15-watt white frosted filament lamps, and in 1952 a 100-watt mercury-vapour lamp with a red-purple filter, which emits a considerable amount of invisible ultra-violet light (3,000–3,800 Å.) but very little light visible to man, was compared with 50- and 100-watt frosted filament lamps, which emit very little ultraviolet light but a considerable amount of light ranging from orange to red and infrared. At equal distances from lamps of equal power, the white light was ten times as intense as the ultraviolet light. When 100-watt lamps were compared, the total catches of insects were slightly greater at the white light. Most Hemiptera, particularly Mirids and Jassids, responded more freely to white light, but of the small numbers of Fulgorids and Aphids caught, most were attracted by the ultraviolet light. Most Diptera and Lepidoptera showed little preference, though Tortricids, Sphingids and miscellaneous Microlepidoptera were rather more attracted to the ultraviolet light. Neuroptera, Hymenoptera and Psocids were more attracted to white light, and Trichoptera to ultraviolet light, while Coleoptera showed varying preferences. Catches at the lights of lower power were small but indicated similar trends.

On the basis of intensity, ultraviolet light was far the more attractive to insects. In general, however, it does not seem more effective than white light, but it could be used where the latter is objectionable, as it is almost invisible at short distances.

Farrar (M. D.). **The Granulated Type Insecticide for Soil Treatment.**—*J. econ. Ent.* **46** no. 2 pp. 377–379. Menasha, Wis., 1953.

Granular formulations of insecticides have been developed to overcome the losses of insecticide by drift that occur when crop land is sprayed or

dusted and to provide a convenient method of applying organic insecticides to the soil, alone or with fertiliser, for the control of insects feeding below the surface. The granular material does not adhere to foliage, but falls through the ground cover on to the soil surface without undue loss.

The insecticides are mixed with granular inert materials of 30–60 mesh size by the processes used in the manufacture of dust base concentrates, the amount of toxicant absorbed depending on the physical properties of the carrier. Suitable carriers are various clays, bentonite and tobacco by-products, and they should be free of dust, which would destroy much of their value. The most bulky one tested was a tobacco by-product that flowed easily and could be handled by all types of equipment when mixed with 5 per cent. toxicant. Granular Attaclay and similar materials absorbed 25 per cent. of certain insecticides and bentonite about 5 per cent.; all but the tobacco by-product tended to pack, which restricted the type of equipment that could be used for their distribution, but the addition of a chemical to induce flow may correct this.

In tests in South Carolina, granular insecticides were successfully applied over difficult terrain by aeroplane at 10 lb. per acre, the swathe width depending on the density of the material; perfect coverage, irrespective of trees or other growth, was obtained with 16 per cent. dieldrin in Attaclay, applied from a height of 85–100 ft. following the usual wing width pattern of flight. Wiring off the agitator was the only change necessary in aeroplanes equipped for dusting. Granular insecticides can also be distributed with tractor-driven row crop duster equipment, the nozzles being kept as high as possible above the soil to give maximum distribution, with a fertiliser attachment or a grass-seed sower, or by hand. Working the material into the soil increases control of underground insects; if this is not done, the amount applied should be doubled. A heavy infestation of the corn earworm [*Heliothis armigera* (Hb.)] on late maize in the whorl stage was completely eliminated within 48 hours by a single application of 5 per cent. granular dieldrin or 25 per cent. granular toxaphene, and good results were obtained with similar treatments against various soil insects.

Cutright (C. R.). **Controlling** *Anuraphis roseus* **and** *Aphis pomi*.—*J. econ. Ent.* **46** no. 2 pp. 379–381. Menasha, Wis., 1953.

The development of insecticides containing phosphorus has permitted control of *Anuraphis roseus* Baker on apple when the Aphids are within the curled leaves. In tests at Wooster, Ohio, in 1951, sprays of 1 lb. 15 per cent. wettable parathion, 1 U.S. pint 50 per cent. malathon emulsion concentrate, or 4 oz. Systox containing 48 per cent. active ingredient [O,O-diethyl O-2-(ethylmercapto)ethyl thiophosphate (demeton)] per 100 U.S. gals. or the same materials at five times these concentrations all gave complete kills of Aphids in curled leaves. Since 15 per cent. wettable parathion reduced the number of fruits per plot showing Aphid injury from 1,030 to 18 when used at 0·5 lb. per 100 U.S. gals. in the pink-bud spray and 1 lb. in the petal-fall spray, and to 256 when used at 1 lb. in the petal-fall spray and 1·5 lb. in the first cover spray, it appears that control of a severe infestation will not be adequate if the first application is delayed beyond the pink-bud stage. Application at the delayed-dormant stage would also give excellent control of the Aphid, but not of other pests that may be present. Preliminary data suggest that it may be possible to predict the future abundance of the Aphid at the time of the pink-bud spray, but further information is necessary on this point.

In field tests against *Aphis pomi* Deg. on apple at Wooster in 1952, sprays of 1 lb. of the wettable parathion, 1 U.S. pint of the malathon concentrate,

4 oz. Systox and 1 U.S. pint nicotine sulphate (with 1 U.S. quart oil) per 100 U.S. gals. gave 100, 99·3, 100 and 93·7 per cent. kill, respectively, in 48 hours and 99·6, 100, 100 and 99·8 per cent. in 120 hours. Spray records show that 25–30 U.S. gals. of an ordinary dilute spray is necessary per tree for adequate coverage, but a spray of parathion at ten times the normal concentration gave 99·9 per cent. kill of the Aphid when applied at only 2·5–3 U.S. gals. per tree, and numerous other tests with concentrated sprays of parathion and Systox have given comparable results.

Finney (G. L.). **A Technique for Mass-culture of the Six-spotted Mite.** —*J. econ. Ent.* **46** no. 2 pp. 381–382. Menasha, Wis., 1953.

Stethorus vagans (Blkb.), a Coccinellid that is predacious on *Tetranychus bimaculatus* Harvey, was introduced into California from Australia in 1951 for insectary rearing, in preparation for liberation in the field during the brief period when conditions are optimum for control of the mite. Attempts to rear *T. bimaculatus* on growing plants in the greenhouse were not very successful, owing to difficulties of temperature control, the space required, competition from insects and attack by a predacious mite of the genus *Typhlodromus* that almost destroyed the cultures and could not be eradicated by TEPP (tetraethyl pyrophosphate], which was used against greenhouse pests on account of its short residual effect. *Tetranychus sexmaculatus* Ril. was therefore introduced as food for *Stethorus*, as it could easily be reared on ripe oranges. Dense populations developed, however, only where the fruits were in contact with one another or with débris, and a fibrous lint, prepared from paper towels, was therefore applied to the fruit surface to encourage feeding. The oranges were stored in a refrigerator until just before treatment, when they were left momentarily in a warm room. The slight condensation formed was used to catch and hold the lint. The oranges were hung in a jar containing a pinch of lint, and this was blown on to them by means of gentle blasts of air through the muslin covering the open top. It was essential not to cover the fruits too thickly.

Medler (J. T.), Fisher (E. H.) & Lycan (G. W.). **Spittlebug Control with Methoxychlor for Hay Production.**—*J. econ. Ent.* **46** no. 2 pp. 383–385. Menasha, Wis., 1953.

As methoxy-DDT (methoxychlor) is effective against nymphs of *Philaenus leucophthalmus* (L.) and does not leave a dangerous residue on forage, it was recommended for control of this Cercopid on leguminous forage crops in Wisconsin in 1952. In tests on 11 farms in Sheboygan County in the same year, applications made to lucerne at the rate of 1 lb. technical methoxy-DDT in about 10 U.S. gals. water per acre on 8th-9th May, when the plants were about a foot high and the eggs were hatching, caused 94·6 per cent. reduction in the number of infested stems and 19 per cent. increase in weight of dry hay. The average infestation of about 50 per cent. of the stems in the untreated plots was unusually low for eastern Wisconsin, where it is commonly 70–90 per cent., and greater benefit would be expected from control of higher insect populations. The increase in yield was greater on 20th June than later in the year, suggesting that spittlebug control may give the best results in conjunction with early harvesting.

In a test in another county to compare a low-volume ground machine with an aeroplane for the application of sprays to lucerne, 1 lb. technical methoxy-DDT [per acre] applied in about 10 U.S. gals. spray by ground

machine resulted in greater reductions in infestation and greater increase in yield than the same quantity in 5 U.S. gals. applied by aeroplane, probably because of more uniform coverage, but both gave conclusive increases in yield over no treatment.

HAMILTON (D. W.). **Notes on the Activity and Control of the Periodical Cicada, 1945 and 1950.**—*J. econ. Ent.* **46** no. 2 p. 385, 1 ref. Menasha, Wis., 1953.

In view of the heavy emergence of brood X of *Magicicada septendecim* (L.) expected throughout much of the eastern United States in 1953, data on the activity and control of brood II in 1945 and brood XXIII in 1950 are summarised.

In eastern New York, emergence of brood II began a few days before 25th May, and oviposition began on 8th June and reached a peak on 15th–22nd June. More than 95 per cent. of the terminals of some unprotected fruit trees were destroyed by the oviposition wounds. Dusting the foliage or adults with 3 per cent. DDT, spraying apple trees with 4 lb. 50 per cent. wettable DDT per 100 U.S. gals. just before the beginning of oviposition, and spraying with ferbam [ferric dimethyldithiocarbamate], phenothiazine, aluminium sulphate with heavy lime, *Ryania* or lead arsenate as repellents were all ineffective.

In southern Indiana, emergence of brood XXIII began on 22nd May and was heavy by 25th May; in one apple orchard, at least 20,000 adults per tree were present on 1st June. Oviposition began on 1st June, reached a peak on 8th–14th June and was completed by about 25th June, and the nymphs hatched between 24th July and 1st September. A spray of 0·25–0·5 pint 40 per cent. TEPP [tetraethyl pyrophosphate] per 100 gals. killed about 80 per cent. of the adults in one application and eliminated them in three [*cf. R.A.E.*, A **38** 213]. As treatment was usually applied only at intervals of a week, owing to the need for applying the usual orchard cover sprays, oviposition was heavy in the most severely infested areas, adults tending to migrate from surrounding woods into the orchards. Spraying was most effective at night or in the early morning, when the adults were resting, and sprayers using high air velocities were better than high-pressure hydraulic sprayers. Field and laboratory tests showed that not only 0·25 pint 40 per cent. TEPP but also 0·5 pint Metacide [6·2 per cent. parathion, 24·5 per cent. methyl-parathion and 2·7 per cent. related organic phosphates] per 100 gals. is effective against the adults, but treatment at intervals of three days or less would probably be necessary for commercial control. Dieldrin, aldrin, parathion, malathon and O-(2-chloro-4-nitrophenyl) O,O-dimethyl thiophosphate had little or no effect on the adults.

It is concluded that the safest and most effective method of protecting the trunks and branches of small trees is to cover the trees with netting during June and wrap the trunks with paper. Frequent applications of TEPP will reduce injury to larger trees.

COREY (R. A.), DORMAN (S. C.), HALL (W. E.) & GLOVER (L. C.). **Translocation Studies with two new Phosphate Insecticides.**—*J. econ. Ent.* **46** no. 2 pp. 386–387, 6 refs. Menasha, Wis., 1953.

The authors describe investigations on the systemic acaricidal properties of diethyl 2-chlorovinyl phosphate (Compound 1836) and dimethyl 1-carbomethoxy-1-propen-2-yl phosphate (Compound 2046) and show their physical properties and the results of preliminary determinations of their toxicity to

mammals in a table. When applied to the lower leaves of broad beans, both compounds were rapidly translocated to the upper leaves, and limited tests with dosages of 0·1, 0·5 and 1 per cent. showed definite dosage responses with the same relative rates of toxicity loss throughout the range, indicating that the toxicants must enter the plants completely soon after application; they probably leave the plant in the transpiration stream; the effectiveness of Compound 1836 disappeared and that of Compound 2046 was greatly reduced after 24 hours.

Evidence that the materials might leave the plants unchanged and that part of the systemic action may be due to fumigation by escaping vapours of translocated chemical was obtained in a test with Compound 1836, in which vapours escaping from plants treated by soil application killed mites on adjoining untreated plants when aerial portions of both plants were enclosed under a battery jar but isolated from the treated soil.

Pritchard (A. E.) & Baker (E. W.). **A Guide to the Spider Mites of deciduous Fruit Trees.**—*Hilgardia* **21** no. 9 pp. 253–272, 15 pls., 1 fig., 22 refs. Berkeley, Cal., 1952.

Sections on the diagnostic characters of the Tetranychid mites that attack deciduous fruit trees and the collection and preparation of specimens are followed by a key to the 12 species recognised in Canada and the United States, a field guide to assist the identification of the adult females, and notes on the individual species. These comprise brief accounts of taxonomic status, characters, biology, food-plants and distribution. One species, *Tetranychus* (*Eotetranychus*) *uncatus*, is new and is described by Garman. It is recorded from apple in Massachusetts and Connecticut, and apparently identical mites were taken on birch in Utah.

Fuller (R. A.), Spinks (J. W. T.), Arnason (A. P.) & McDonald (H.). **Use of radio-active Tracers in Investigations on Soil-inhabiting Insects.** —*81st Rep. ent. Soc. Ont. 1950* pp. 7–15, 4 figs., 2 refs. Toronto, 1951.

The authors describe experiments carried out in Canada, in which wireworms (*Ctenicera aeripennis destructor* (Brown)) and cutworms (*Euxoa ochrogaster* (Gn.) and *Agrotis orthogonia* Morr.) were marked with radioactive cobalt (Co^{60}) for observations on their behaviour in the soil. This material was chosen because the comparatively high energy of its gamma radiation makes detection possible through several inches of soil and its long half-life minimises corrections for decay; the larvae studied are slow-moving and unlikely to be lost, so that an isotope with a long half-life could be used without much danger.

Pieces of cobalt wire, 1 mm. long, 0·25 mm. in diameter and 0·5 mg. in weight, with an initial activity of about 0·022 millicurie, were used. These were placed in the caudal notch of the wireworms and attached to the ninth segment and the urogomphi with a fast-drying acetone-soluble cement, and seemed to cause no ill effects over a period of three months. Most of the wireworms were reared until they shed the wire by moulting; many lacked recognisable urogomphi after moulting, whereas individuals similarly treated with inactive wire did not. Insertion of cobalt wire, either radioactive or inactive, into the wireworms killed them in 3–5 days, although insertion of inactive silver or platinum wire caused little mortality. All parts of the bodies of wireworms treated with radioactive wire became radioactive, indicating that some of the cobalt had been dissolved and

distributed; silver-plated cobalt wire was also lethal, but after a longer period.

Most of the cutworms were unaffected by the insertion of radioactive cobalt wire into the body cavity, but a small proportion died, with symptoms similar to those of the wireworms; their faecal matter was highly radioactive, and radioactivity was distributed throughout the bodies. The faecal matter of surviving larvae contained very small traces of activity, and it is suggested that the death of the others was due to puncturing of the digestive tract, which would allow the cobalt to be dissolved by the digestive fluids and distributed throughout the body, causing cobalt poisoning. This theory also explains the lethal effect on the much smaller wireworms and was substantiated when cutworms containing radioactive wire were devoured by others. The latter showed a high concentration of radioactivity throughout the body, had highly active faecal matter and died within three days.

Preliminary tests with buried wire showed that a Geiger counter with a movable probe located it to within a quarter of an inch in the horizontal plane at depths of 5 ins. or less. The variations in counting rate with soil depth and density were determined for each piece of wire and plotted on a graph; since the rate of decay is slow, recalibration is not necessary more than once every six months. For soil densities of 0·23–0·43 gm. per cu. in. and moisture contents of 6–16 per cent., the counts agreed sufficiently for a given soil depth to be measured to within a quarter of an inch. The positions of radioactive larvae were determined by moving the probe over the surface to the position at which the counting rate was greatest, which showed the horizontal location, and referring the count to the graph to find the depth. Tests with a wireworm confined in sand between glass plates showed that this method was accurate.

To observe the effect of temperature on wireworms, a temperature-gradient apparatus was constructed with a range of 32–120°F., and the movements of larvae put in the hot region or at points where the temperature was below 55°F. were followed, counts being taken until they remained in the same place for several consecutive readings. The larvae moved rapidly from regions with temperatures over 90°F., slowed down in those between 90 and 80° and appeared to prefer the range of 72–76°. Larvae placed in the region below 55° usually remained there. In chambers in which wireworms were offered alternative soil-moisture conditions, of 6–8 and 12–18 per cent., those in the dry region left it for the wet one, and those in wet soil did not leave it or returned to it immediately, except when a piece of potato was put in the dry soil within 4 ins. of the boundary. The paths of several wireworms seeking food were followed; both rates and routes varied greatly. Observations on rates of movement showed that one individual moved 6 ins. in ten minutes and others 10–12 ft. in several hours.

Cutworms kept in cages consisting of circular galvanised-iron bands pushed into the soil to a depth at which escape appears impossible usually become reduced in numbers within a few days. Observations on radioactive examples showed that cannibalism, rapid decay after death and the ability to escape were all responsible.

Monro (H. A. U.). **The Relation of Space Fumigants to the Problem of Insect Resistance to Insecticides.**—*81st Rep. ent. Soc. Ont. 1950* pp. 37–41. Toronto, 1951.

The development of resistance to hydrocyanic acid gas has been demonstrated in the field in *Aonidiella aurantii* (Mask.) [*cf. R.A.E.*, A **38** 442, etc.] and in the laboratory in *Tribolium confusum* Duv. [**28** 199], and it is shown that if fumigation of plant products in connection with quarantine

restrictions, or of empty carriers, such as the holds of ships, does not give complete insect kill, there is a danger of disseminating resistant individuals, from which a resistant strain may develop, about the world. The number of chemicals that can be used as fumigants is limited on grounds of volatility to those with comparatively simple molecules, and as the margin of safety between toxicity to insects and toxicity to man or danger to perishable materials is usually small, a need to deal with increased resistance by increasing dosages of fumigants or prolonging the exposure period would involve serious difficulties.

Pielou (D. P.). **Selection for DDT Tolerance in** *Macrocentrus ancylivorus*. —*81st Rep. ent. Soc. Ont. 1950* pp. 44–45. Toronto, 1951.

The author summarises the results of investigations already noticed [*R.A.E.*, A **40** 183] on the resistance to DDT and on other physical characteristics of survival of over 50,000 young adults of a laboratory stock of *Macrocentrus ancylivorus* Rohw. from which it was hoped to breed a resistant strain. A continuous breeding unit was used, and newly-emerged adults were removed daily and exposed to films of 23 mmg. DDT per sq. cm. for three minutes, after which the survivors were returned to the unit and used as parents. As a result of breeding from these for more than four overlapping generations over a period of 90 days, survival for 40 hours after exposure increased from about 30 to 90 per cent., and a film of 69 mmg. per sq. cm. was required to reduce survival to 30 per cent. The selected stock is therefore considered to be about three times as resistant as the original one.

Dustan (G. G.), Putman (W. L.) & Boyce (H. R.). **Results of Spraying for the Control of the Oriental Fruit Moth,** *Grapholitha molesta* **(Busck), in Ontario, 1946–1950.**—*81st Rep. ent. Soc. Ont. 1950* pp. 50–72. Toronto, 1951.

In Ontario, infestation of peach by *Cydia* (*Grapholitha*) *molesta* (Busck) was less severe in 1946 than in 1945 [*cf. R.A.E.*, A **36** 167], but increased in intensity in 1947–48, after which it was again greatly reduced, owing partly to the use of DDT but also to climatic factors and parasitism. Larvae of the first generation feed in the twigs in late May and June, those of the second in the twigs and fruits in July and early August, and those of the third and the partial fourth in the fruits during the rest of the season. In the control experiments described, the insecticides were wettable powders containing DDT or parathion, and EPN-300, a wettable powder containing 27 per cent. O-ethyl O-p-nitrophenyl benzenethiophosphonate, and all spray quantities mentioned are per 100 gals. except when amounts of insecticide are given per acre.

Experiments carried out in 1946–50 on the use of DDT sprays for the prevention of fruit injury and observations on commercially treated trees showed that increasing the number of applications to a maximum of 6–7 increases control, but that the programme giving the most economic results varies with the intensity of infestation, the value of the crop and the cost of labour and materials. Attempts to forecast the degree of fruit infestation having proved unsuccessful, a regular schedule that will give good control of heavy infestations is necessary. Sprays against the first generation improved control, but treatments against the second and third only were generally satisfactory, provided that they were applied thoroughly; also, the earlier applications are likely to disturb biological control by destroying

parasites and to permit increases in infestation by *Paratetranychus pilosus* (C. & F.) (*Metatetranychus ulmi*, auct.). However, in orchards in which severe damage is likely nearly every year, a full programme against all three generations is justified. Two sprays of 2 lb. 50 per cent. DDT should be applied against the second generation, three giving little if any better control. Only one application is necessary against the third generation, but it is important, as fruits infested by this generation often show no external injury and pass unnoticed at harvest. To prevent excessive residues, the amount of DDT powder in this spray was reduced to 1 lb. It was recommended in 1949–51 that the first spray should be applied 3–4 days before the peak of flight of the second generation, the second two weeks later, and the third 3–4 weeks before harvest, and the same schedule was likely to be recommended for some years; only bearing orchards are treated. As a result of the use of DDT, at least one and usually 2–3 acaricidal sprays have been needed each year to control *P. pilosus*, but *Macrocentrus ancylivorus* Rohw., the most important parasite of *C. molesta*, has been affected less than was feared, possibly because few young orchards are sprayed.

In 1948, when 25 per cent. parathion at 2 lb. in one spray against the second generation and at 1 lb. in two against the third was compared with 2 lb. 50 per cent. DDT in all three, parathion gave at least as good control of the second generation as DDT, but failed to give protection against the third. In 1949, when 15 per cent. parathion was used at 1 lb. in two sprays against the second generation and one against the third, it was as effective as DDT against the second generation, but less so against the third in one orchard. The addition of 0·75 lb. 15 per cent. parathion to DDT sprays against the second generation did not improve control. In a comparative test in 1950, in which three sprays were applied against the first generation, two against the second and one against the third, 50 per cent. DDT at 1·5 lb. in the last application and 2 lb. in all the others was rather more effective than 1 lb. 15 per cent. parathion, and 0·75 lb. EPN-300 was the least effective, especially against the third generation. Two applications of 1 lb. EPN-300 against the second generation, followed by one of DDT against the third, were less effective than three of DDT. As 1 lb. 15 per cent. parathion gives good control of *P. pilosus* and the Coccid, *Pulvinaria occidentalis* Ckll., which are not affected by DDT, it was recommended as an alternative in the two sprays against the second generation for use where the Coccid needs controlling; it should not replace DDT completely because of the danger to man. When 50 per cent. DDT was applied in 1946–49 at 2 lb. in 1–3 sprays or at 1·5 lb. in the last of 2–4 sprays and at 2 lb. in the earlier ones, the residues on the fruit at harvest were much above any suggested tolerance; no results were available for 1950, when only 1 lb. was used in the last spray. Parathion residues were variable, but not excessive.

In further tests, DDT, parathion and EPN-300 were compared for the control of twig-infesting larvae. When applied four times against the first generation and twice against the second in 1947, 0·75 or 2 lb. 15 per cent. parathion gave better control than 2 lb. 50 per cent. DDT against both generations; no injured twigs were found on trees treated with parathion until more than ten days after the fourth application, whereas there were 213 and 16–26 per plot on untreated trees and those receiving DDT, respectively, by that time. Probably no sprays protected rapidly growing twigs for more than five days. When applied three times against the first generation and twice against the second in 1950, 1 lb. 15 per cent. parathion was superior and 0·75 lb. EPN-300 inferior to 2 lb. 50 per cent. DDT. To determine the direct effects of the insecticides on the larvae in the twigs,

untreated trees were sprayed with 0·75 or 2 lb. 15 per cent. parathion on 6th June 1949, and larvae were dissected from injured twigs three days later. Mortality was 20·7 per cent. on trees receiving 0·75 lb. and 80·7 per cent. on those receiving 2 lb. In a similar test, examination on 30th June of larvae from twigs sprayed on 28th June showed that 0·75 lb. 15 per cent. parathion had killed 60·9 per cent. of them and 2 lb. 50 per cent. DDT none.

In 1949 and 1950, a concentrate mist sprayer was compared with an ordinary high-pressure sprayer for the application of DDT. Equally good control of fruit infestation was obtained with dosages of 7·5 lb. 50 per cent. DDT per acre in the first two applications and 5·6 lb. in the third in normal sprays and of 12·2 lb. 50 per cent. DDT per acre in the first two and 9 lb. in the third in mist sprays at 7·5 times the normal concentration in 1949 and with dosages of 7·2 lb. 50 per cent. DDT per acre in the first two and 6 lb. in the third in normal sprays and of 6·6 lb. in the first two and 4·8 lb. in the third in mist sprays at about 3·3 times the normal concentration in 1950.

HALL (J. A.). **Chemical Control of the Oystershell Scale in the Georgian Bay Area of Ontario.**—*81st Rep. ent. Soc. Ont. 1950* pp. 81–85. Toronto, 1951.

Lepidosaphes ulmi (L.) increased in abundance on apple near Georgian Bay, Ontario, after 1940 and was killing branches and whole trees by 1946. In tests of control measures in six orchards in 1947–49, sprays were applied against the overwintering eggs when the buds were still dormant or only slightly swollen and the temperature was 40–55°F. and against newly hatched crawlers at petal-fall, when the weather was moderately warm and about 50 per cent. of the eggs had hatched. None of the treatments appeared to damage buds or foliage. Spray quantities are given per 100 gals., and control percentages are calculated according to Abbott's formula [*R.A.E.*, A **13** 331].

Dormant applications of 5 gals. regular tank-mix oil, 4 gals. "superior" tank-mix oil, 5 gals. regular emulsifiable oil or 1 gal. Elgetol (19·95 per cent. of the sodium salt of DNC) or Krenite (25 per cent. of the same salt) all gave more than 96 per cent. control, and petal-fall applications of 2 lb. 50 per cent. DDT, alone, with 0·5 pint HETP (hexaethyl tetraphosphate) or with 5 oz. dinex and 2 fl. oz. aqua ammoniae or monoethanolamine, of 1 lb. 15 per cent. parathion or of 1 gal. summer oil, alone or with 1 pint nicotine sulphate gave more than 93 per cent. Treatment with dinosam (triethanolamine) or lower concentrations of oil at the dormant stage or with parathion 12 days after petal-fall was much less effective. The DNC preparations were toxic to the eggs, but the dormant oils acted by killing the newly-hatched crawlers.

Paratetranychus pilosus (C. & F.) (*Metatetranychus ulmi*, auct.) was the most important of the other pests present, and caused serious damage in 1947 on untreated plots and on those receiving DNC, but not on those treated with oils or acaricides (HETP and dinex); in 1948 and 1949, winter eggs of the mite were particularly numerous in plots treated with DDT, much less so in the DNC plots and almost absent from those receiving dormant oils or parathion. *Typhlocyba pomaria* McAtee was numerous in 1948 and caused marked foliage injury in plots treated with dormant or summer oil or DNC, but not in those receiving DDT or parathion at petal-fall. Neither dormant nor petal-fall treatments reduced damage by *Cydia* (*Carpocapsa*) *pomonella* (L.).

In a discussion of these results, it is pointed out that dormant treatments must be applied as extra sprays, whereas summer ones can be combined with the regular calyx spray, and the latter are therefore preferable where

the scale alone is important. If *Spilonota ocellana* (Schiff.), *Coleophora occidentis* Zell., or *Anuraphis roseus* Baker are numerous, a DNC spray will control them as well as the scale, but it will not control *Tortrix* (*Archips*) *argyrospila* (Wlk.) and may lead to an increase in mites. Dormant oils control *L. ulmi* and also *T. argyrospila* and *Quadraspidiotus* (*Aspidiotus*) *perniciosus* (Comst.), and reduce mites, but do not control *S. ocellana*, *C. occidentis*, *T. pomaria* or *Anuraphis roseus*. Parathion at petal-fall controls *L. ulmi*, *P. pilosus* and *T. pomaria*. DDT is very effective against *L. ulmi* and *T. pomaria* but favours increases in *P. pilosus*.

Kelley (R. A.). **Preliminary Tests of a systemic Insecticide for the Control of Aphids on Potatoes.**—*81st Rep. ent. Soc. Ont. 1950* pp. 86–88, 4 refs. Toronto, 1951.

In the tests described, which were carried out in New Brunswick in 1950, O,O-diethyl O-2-(ethylmercapto)ethyl thiophosphate (referred to as Systox) was used at 2 lb. per 100 gals. The liquid was applied as a spray to the drills at the rate of 125 gals. per acre immediately before planting, on 23rd June, as a dip to the pieces of seed potato immediately before they were planted, or as a spray to the plants at the rate of 125 gals. per acre on 13th July, a week after they first showed above ground. The plants were top-killed on 11th September and dug on 15th September. Weekly counts of Aphids on these and untreated plots from 18th July to the end of August showed that *Myzus persicae* (Sulz.), *Macrosiphum solanifolii* (Ashm.) and *Aphis rhamni* Boy. (*abbreviata* Patch) were present and that spraying the drills gave the best and only consistent control, reducing the numbers throughout the season as compared with no treatment. The decrease gradually became less as the season progressed, but was still 51 per cent. on 23rd August. Reduction by the other treatments became erratic after 24th July. Tubers from plants receiving the three treatments contained 0·5, 1 and 0·25 parts per million of the chemical.

Oughton (J.). **"Tagging" Root Maggot Flies** (*Hylemya* **spp., Anthomyidae) by Means of radioactive Phosphorus.**—*81st Rep. ent. Soc. Ont. 1950* pp. 91–92. Toronto, 1951.

An account is given of experiments carried out in Ontario in 1950 in a field of early turnips that was heavily infested by *Hylemyia* spp. early in the season. On 4th July, a dilute solution containing radioactive phosphorus (P^{32}) was poured on the soil at the base of the plants so that two lots of 24 plants received totals of 0·8 and 0·2 millicurie P^{32}, respectively, and a third lot was left untreated. Half the plants in each series were covered with a cheese-cloth cage from 13th July to 14th August, and adults of *Hylemyia* taken in the cages were tested for radioactivity with a Geiger-Müller counter. Of ten taken on the plot treated with 0·8 millicurie P^{32}, three, all males, were radioactive, whereas none of six taken on that treated with 0·2 millicurie and none of three taken on the untreated plants was radioactive. Net sweeps were made twice in July and six times in August at four positions in the field, one including treated plants and the most distant being about 300 yards away. The Anthomyids taken were killed and examined, but none was radioactive. Examination of one turnip and the surrounding soil from the heavily treated lot on 19th July revealed four puparia and two larvae of *Hylemyia*, all of which were strongly radioactive. Marking in this way with radioactive phosphorus may facilitate the study of the dispersal, local distribution and habits of *Hylemyia* spp. and their parasites.

da Costa Lima (A.). **Duas espécies de *Gitona* predadoras de Coccideos do gênero *Orthezia* (Diptera: Drosophilidae).** [Two Species of *Gitona* predacious on Coccids of the Genus *Orthezia*.]—*Arthropoda* **1** no. 2–4 pp. 247–253, 3 figs., 4 refs. Buenos Aires, 1950. (With Summaries in Spanish & English.)

Descriptions are given of the adults of *Gitona brasiliensis* and *G. fluminensis*, spp. n., both from Brazil. *G. brasiliensis* was found preying on several species of *Orthezia*, including *O. praelonga* Dougl. on *Citrus*, and is the species previously recorded as an unnamed Anthomyzid [*R.A.E.*, A **26** 319], and *G. fluminensis* was predacious on an unidentified species of *Orthezia* on a garden plant.

Robbs (C. F.). **O hexacloreto de benzeno (BHC) no combate ao mandarová da mandioca (*Erinnyis ello* L.).** [BHC for the Control of *E. ello*.]—*Agronomia* **8** no. 4 pp. 337–340, 2 figs., 3 refs. Rio de Janeiro, 1949.

Erinnyis ello (L.) causes severe injury to cassava (*Manihot utilissima*), especially the young plants, near Rio de Janeiro, Brazil, and experiments on its control [*cf. R.A.E.*, A **38** 40] were carried out in 1949. In the laboratory, a dust of 0·5 per cent. parathion (Rhodiatox) killed only the young larvae, and one of 5 per cent. DDT was only slightly better; both were unsatisfactory in the field. A dust of 2 per cent. γ BHC gave complete mortality of larvae of all instars in the laboratory, and though in field tests it did not prevent larvae in the last instar from pupating, adults emerged from only 30 per cent. of the pupae. The BHC was injurious to the young leaves when excessive deposits accumulated on them, but this did not affect production or taint the roots. BHC was widely used by growers in March against the second generation, before the larvae had time to cause much damage.

Conservación de granos y almacenamiento en silos subterráneos. Memoria preparada por el Servicio de Silos Subterráneos. [Grain Conservation and Storage in underground Silos. Memorandum prepared by the Underground Silo Service.]—222 pp., 3 col. pls., 90 figs., refs. Buenos Aires, Minist. Agric. Argent., 1949.

This report consists of four parts, the first two and the last of which concern work begun in 1941 on the storage of wheat and maize in specially constructed pits in Argentina. Simple pits lined with straw proved unsatisfactory. Brick-lined pits were somewhat better, but much the best results were given by large rectangular pits with sloping walls made of a mixture of cement, sand and earth that were lined with bitumen to make them water- and gas-tight. They were hermetically sealed with tarred paper when full, and sometimes covered with earth and straw in addition, though this was found unnecessary when the paper itself was sealed with bitumen. The relative humidity of the grain when stored should not exceed 13–13·5 per cent. The carbon dioxide resulting from the respiration of the grain and of any insects in it is retained and insects are thereby eventually asphyxiated, while the thermal insulation obtained prevents the formation of pockets of high humidity, with consequent deterioration and heating.

In an early experiment in 1942, the paper covers were punctured by larvae and adults of *Tenebroides mauritanicus* (L.) and some of the grain was infested, but they did not penetrate more than two inches beneath the surface. Damp caused some loss of grain near the perforations, but the

damage was slight. When the pit was emptied after 13 months, less than 3 per cent. of the grain showed deterioration. Following this and other experiments, treatment of the paper covering with bitumen was recommended. During 1944–47, 1,187 pits arranged in groups at places throughout the country were filled with an average of about 580 tons of wheat each and opened after periods of 9–44 months, with losses of only 0·03–0·75 per cent. of the grain.

The third part contains an account of experiments carried out in 1942–43 on methods of treating infested surface-stored grain. Inert dusts were satisfactory for wheat but not for maize, various proprietary sprays of unspecified composition were unsatisfactory, and fumigation, chiefly of maize, with hydrocyanic acid gas or a proprietary mixture of ethylene dichloride and carbon tetrachloride (3 : 1) gave very good results when applied under favourable conditions. Sulphur dioxide, produced by burning sulphur, was effective for treating infested empty sacks.

Blanchard (E. E.). **Un nuevo parásito del gorgojo del tabaco.** [A new Parasite of the Tobacco Weevil.]—*Rev. Invest. agric.* **4** no. 1 pp. 135–138, 1 fig., 3 refs. Buenos Aires, 1950.

The Pteromalid, *Eurydinoteloides ogloblini*, sp.n., is described from four females reared from larvae of the tobacco stem borer, *Faustinus cubae* (Boh.), taken on *Solanum sisymbriifolium* in Misiones, Argentina, in March 1949.

Chiarelli de Gahan (A.). **"*Proxenus rionegrensis*," nuevo Lepidóptero de la Argentina (Lep. Noct. Acronyctinae).** [*P. rionegrensis*, a new Species of Lepidoptera from Argentina.]—*Rev. Invest. agric.* **3** (1949) no. 4 pp. 397–402, 2 figs., 2 refs. Buenos Aires, 1950.

Chiarelli de Gahan (A.) & Touron (E. A.). **Datos biológicos de *Proxenus rionegrensis* (i.l.).** [Biological Data on *P. rionegrensis*.]—*Op. cit.* **4** no. 1 pp. 139–151, 3 figs., 7 refs. 1950.

Descriptions are given in the first paper of the adults of both sexes of *Proxenus rionegrensis*, sp.n., reared from larvae found in 1945 in Rio Negro, Argentina, in bands of corrugated cardboard placed on apple trees to trap larvae of *Cydia (Carpocapsa) pomonella* (L.).

In the second paper, the egg, larva and pupa of *P. rionegrensis* are described, and an account is given of laboratory studies on its bionomics in 1945–48. The adults emerged in early August, and since it was thought that the presence of the larvae on apple might have been accidental, leaves of several other plants were provided as food for the larvae reared. They fed on lucerne, lettuce and cabbage, but apple was much preferred and subsequent generations were therefore reared on it.

At laboratory temperatures ranging from 16 to 28°C. [60·8–82·4°F.], the females oviposited 1–7 days after emergence, laying an average of about 250 eggs each, singly on the leaves. The egg and pupal stages lasted 3–23 and 6–21 days, respectively, the larval stage ranged from 21 days in summer to 133 in winter, and complete development varied from 36 to 149 days for individuals emerging in December and August, respectively. The larvae fed on the parenchyma of the leaves, leaving only the veins, and are probably kept in check by the measures applied against *C. pomonella*. Two unidentified Tachinids were reared from them, but parasitism was very low.

Berry (P. A.). **Biology and Habits of Cotton Stainers (Hemiptera: *Dysdercus* spp.), their natural Enemies in South America, and two parasitic Flies imported into Puerto Rico.**—*Rev. Ent.* **22** fasc. 1–3 pp. 329–342, 3 figs., 5 refs. Rio de Janeiro, 1951.

Sabrosky (C. W.). **Notes on Trichopodini (Diptera, Larvaevoridae), with Description of a new Parasite of Cotton Stainers in Puerto Rico.**—*J. Wash. Acad. Sci.* **40** no. 11 pp. 361–371, 11 figs. Menasha, Wis., 1950.

Collections of *Dysdercus peruvianus* (Guér.) on cotton in Peru, and to a less extent of other species of *Dysdercus* in Argentina and Uruguay, were made in 1941–45 with a view to rearing parasites from them for introduction into Porto Rico for the control of *Dysdercus* spp. on cotton there. An account of the work is given in the first of these papers, together with a discussion of the distribution of *Dysdercus* spp. in South America, records of their wild food-plants, descriptions of the topography and climate of the cotton-growing areas of Peru and notes on the effect of these and of cultural methods on infestation. *D. peruvianus* was abundant in all the areas visited, but the degree of damage varied largely with the weather in spring, since migration from the wild food-plants in the hills to cotton in the valleys does not occur until the former have been dried up by the sun. When this migration occurs early, damage is severe.

The parasites reared from *D. peruvianus* in significant numbers comprised the Tachinids, *Hyalomyia chilensis* Macq. and *Acaulona peruviana* Tns. The field-collected *Dysdercus* adults were liberated in cloth-covered cages measuring 36 × 20 × 36 ins. containing trays of moistened cotton seeds for food and having a base of wire netting with a mesh of $\frac{1}{8}$ inch, which permitted the full-fed parasite larvae to fall into a tray of damp cotton placed beneath, but retained host individuals. The females oviposited soon after confinement, and some of the parasite larvae were destroyed by the resulting nymphs before they fell to the tray. The highest percentage of parasites was recovered with 5,000 hosts per cage, but up to 25,000 could be accommodated with fairly good results. The percentage parasitism by *A. peruviana* in the different collections ranged from less than 1 to 20 but was seldom more than 8. In rearing experiments, the egg, larval and pupal stages lasted 4, 16–20 and 12–18 days, respectively, at 70–80°F., and the adults survived for 14–30 days when kept in a cool dark place and given honey and water. *H. chilensis* could not be induced to oviposit under the conditions provided, although pairing occurred in confinement, but observations on field-collected material indicated that the egg and larval stages together lasted 14–21 days. The pupal stage lasted 12–18 days at 70–80°F., and the adults survived for 14–21 days when kept under the same conditions as those of *A. peruviana*. Both Tachinids occurred throughout the coastal areas of Peru and were attacked by a secondary parasite, *Perilampus* sp.

Acaulona brasiliana Tns. was reared from *D. ruficollis* (L.) and *D. mendesi* Blöte from the Argentine Chaco, but emergence was very protracted. The pupal stage lasted 16–19 days, and the habits of this Tachinid apparently resembled those of *A. peruviana*. Several collections of *D. albofasciatus* Berg on *Pavonia* sp. were made in Uruguay, but no parasites were obtained.

As a result of the work, totals of 233 adults and 2,629 puparia of *H. chilensis* and 430 adults and 3,408 puparia of *A. peruviana* were sent to Porto Rico in 1941–42 [where they were apparently recorded as having been reared from *D. ruficollis* (*cf. R.A.E.*, A **32** 343; **33** 312)].

In the course of the second paper, the author gives descriptions of *A. brasiliana*, *A. peruviana*, which is stated not to have been recovered in Porto

Rico after its liberation, possibly owing to host specificity, no species of *Dysdercus* occurring in both Peru and Porto Rico, and *A. erythropyga*, sp.n., which was reared from *D. andreae* (L.) and *D. sanguinarius* Stål in Porto Rico.

Callan (E. McC.). **Biology of *Dinurothrips hookeri* Hood (Thysanoptera, Thripidae).**—*Rev. Ent.* **22** fasc. 1–3 pp. 357–362, 9 refs. Rio de Janeiro, 1951.

The distribution and food-plants of *Dinurothrips hookeri* Hood are discussed from the literature. In Trinidad, minor infestations have been observed on tomato, garden annuals (including *Gerbera* and *Zinnia*) and *Ageratum conyzoides*, and occasional individuals have been noticed on other plants, but sweet potato, which is infested in other countries [*cf. R.A.E.*, A **19** 14, 172; **24** 691], is not attacked.

The thrips was reared in the laboratory on disks cut from fresh leaves of tomato, *Gerbera* and *Zinnia* on moistened blotting paper in petri dishes. No males were observed at any time, and the mean durations of the egg, nymphal, prepupal and pupal stages, which are briefly described, were 7·4, 7·2, 1·2 and 3 days, respectively, at about 82°F. The predacious thrips, *Franklinothrips vespiformis* (Crwf.), was found attacking the nymphs in the field, and the nymphs were readily parasitised in the laboratory by the Eulophid, *Dasyscapus parvipennis* Gah., several generations of which were reared.

Peretz (I.) & Plaut (N.). **Control of Olive Fly in Israel.**—*FAO Plant Prot. Bull.* **1** no. 7 pp. 101–103. Rome, 1953.

In Israel, early varieties of olive, which are generally grown in coastal districts, become infested by *Dacus oleae* (Gmel.) as early as the end of May, and infestation may be as high as 90 per cent. by the end of June; the infested fruits fall, but at harvest, in August–September, 20–100 per cent. of the fruits still on the trees are usually infested. Since 1925, a bait-spray of Dachicida [*cf. R.A.E.*, A **27** 98, etc.], applied according to the Berlese method, has been recommended for control, but it proved doubtfully effective and injured the fruits and leaves. In 1940–44, tests of this bait-spray and of others containing sodium arsenite and sugar-beet molasses or sugar, the latter with or without the addition of ammonium sulphate, gave inconclusive results, but in further tests in 1951–52, using a modification in method that had been successful in Greece and involved spraying the lower surfaces of the leaves, excellent control was obtained. Six applications, coinciding with increases in the numbers of flies taken in traps, were made between May and the beginning of August throughout an isolated grove that had been heavily infested in previous years, and all the fruit was uninjured at harvest, whereas 90–100 per cent. of that in the nearest untreated groves was damaged.

Bait-traps containing 4 per cent. diammonium phosphate, used at the rate of 3–10 per tree and set up at the beginning of May, about two weeks before infestation began, were ineffective in 1951, and dusts and sprays of DDT, BHC, an arsenical, and cryolite gave inconclusive results in 1945–48. DDT showed some promise, but was unsatisfactory in further tests in 1949 and 1950. In 1951, wettable-powder sprays containing 0·5 per cent. DDT or methoxy-DDT (methoxychlor) or 0·3 per cent. dieldrin, all with 2 per cent. sugar-beet molasses as an attractant, were tested in a grove containing three early varieties and the most widely cultivated late variety. The trees were sprayed thoroughly from the inside and outside,

and the first two materials were applied four times between 6th June and 17th August and dieldrin three times between 6th June and 27th July. At harvest, in late August, the percentages of uninfested fruit in general exceeded about 90, as compared with about 46–81 for no treatment, and not more than 18·2 per cent. were scorched by the molasses. The greatest benefit was obtained on an early variety that is usually heavily attacked early in the season. Sprays of methoxychlor and dieldrin are costly, but their use, with or without an attractant, is recommended for early varieties of high productivity or where the treatment of an entire area with bait-sprays is impracticable.

Outbreaks and new Records.—*FAO Plant Prot. Bull.* **1** no. 7 pp. 106–109. Rome, 1953.

W. J. Hall reports (pp. 107–108) that *Oryctes rhinoceros* (L.) was recorded for the first time in Fiji early in 1953, when a light infestation on coconut was found extending for about eight miles along the coast west of Suva, and (p. 109) that *Phytobia* (*Dizygomyza*) *cepae* (Her.), which was previously known only from Germany, Austria, the Soviet Union and Japan, was found in 1952 attacking shallots in Singapore. A subsequent survey on the island showed that this leaf-miner was too widely distributed to be eradicated.

Paulian (R.). **Insectes utiles et nuisibles de la région de Tananarive.** —*Publ. Inst. Rech. sci. Tananarive* [1+] 120 pp., 6 pls., 192 figs., 74 refs. Tananarive-Tsimbazaza, 1950.

The main section of this booklet consists of a systematic list of the insects that are of economic importance near Tananarive, in eastern Madagascar. Most of them are injurious to plants, but some are parasitic or predacious. All are briefly described, and notes are given on the habits, food-plants and control of the injurious ones. An introductory section contains general information on control methods, and there are two appendices, one comprising a list of insects that are not specific to cultivated plants, have been recorded from Madagascar but have not been collected there lately, or are of uncertain identity, and the other containing notes on mites and nematodes that injure plants in Madagascar.

Cachan (P.). **Les termites de Madagascar et leurs dégâts.**—*Publ. Inst. Rech. sci. Tananarive* [1+] 29 pp., 38 figs., 28 refs. Tananarive-Tsimbazaza, 1950.

The first part of this work contains lists of the termites that attack structural timbers and wood products, injure living plants or trees or are a nuisance in the soil in Madagascar, with brief notes on their local distribution and habits and descriptions of the soldiers of the more important species. The second part contains information on measures for preventing and controlling termite attack, with lists of resistant timbers.

Andrewartha (H. G.) & Kilpatrick (D. T.). **The Apple Thrips.**—*J. Dep. Agric. S. Aust.* **54** no. 12 pp. 586–592, 595, 4 figs. Adelaide, 1951.

Apple crops in South Australia were lighter than expected in 1950–51, especially in late districts where rainfall is high and in orchards of poor

vigour and with inadequate facilities for cross pollination. Leaf-scab and *Bryobia* [*praetiosa* Koch] had been fairly prevalent in previous years, and these and other causes of low vigour may have been partly responsible, but the apple thrips [*Thrips imaginis* Bagn.] was unusually numerous in 1950, following favourable weather conditions during autumn, winter and spring [*R.A.E.*, A **28** 442]. The evidence as to the importance of this thrips in causing crop losses was conflicting, since although low yields in 1914–15, 1926–27 and 1931–32 were associated with high populations, good crops were obtained in 1938 and 1939, when numbers were almost as high as in 1950. The bionomics of *T. imaginis* and the damage due to it are described [**32** 141]. Pollination is delayed on infested trees owing to the destruction of the pollen and stigmas by the thrips, but it may also result from lack of vigour, and experience during 1933–40 indicated that very large numbers of the thrips are needed to prevent pollination on vigorous trees. In 1950–51, a survey of 30 orchards by D. T. Kilpatrick showed that trees on which the thrips populations were kept low during the flowering period by two applications of emulsified solutions of 0·1–0·05 per cent. DDT or 0·01–0·0075 per cent. parathion (E605), made at the pink-bud stage and between full bloom and petal-fall, bore much heavier crops than unsprayed trees, and a single application at full-bloom was followed by quite a marked improvement, provided that the flowers were reasonably free from damage on opening. No injury to the fruit or foliage resulted when DDT was combined with lime-sulphur. Flowers that had been protected at the pink-bud stage were more attractive to bees than damaged ones, and no evidence was obtained of mortality among bees from the sprays.

The recommendations made are mainly directed towards ensuring rapid pollination, and comprise the use of cultural measures that will maintain the trees in a vigorous condition and the provision of adequate facilities for cross-pollination. Although the population density of *T. imaginis* depends primarily on weather, it may be influenced by the nature of the cover crop and the date of ploughing. If it becomes great enough to warrant the use of insecticides, a spray of 0·1 per cent. DDT at the early pink-bud stage is recommended, followed by another when 50–75 per cent. of the flowers have opened.

[Bobinskaya (S. G.).] Бобинская (С. Г.). **The Causes of the Resistance to BHC of certain noxious Soil-inhabiting Larvae.** [*In Russian.*]—*Dokl. vsesoyuz. Akad. sel.-khoz. Nauk Lenina* **18** no. 2 pp. 30–33, 3 refs. Moscow, 1953.

In laboratory tests in which larvae of *Melolontha melolontha* (L.), *Cleonus* (*Bothynoderes*) *punctiventris* (Germ.) and *Melanotus rufipes* (Hbst.) were kept for a day in soil treated with a 5 per cent. BHC dust at the rate of 900 lb. per acre and then transferred to untreated soil, there was a slight increase in the intensity of respiration and a reduction in weight for three days after treatment, after which the larvae returned to their normal state, and similar results were obtained when they were kept in the treated soil for five days. The disturbances in metabolism were more pronounced when the soil was treated at 270 lb. per acre, and the larvae kept in it for 20 days. The intensity of respiration increased sharply and their contents of water and fats fell, especially in the case of *Melanotus*. As a result of the loss of water, the body juices of the larvae became more concentrated and their freezing points were lower. The change was greater in first-year larvae of *Melolontha*, the respiration of which is very intense, than in those 3–4 years old, and was again greatest in *Melanotus*.

The changes were less pronounced in the field, probably because the larvae migrated to deeper layers in the soil. *Melanotus* was again more susceptible than the two other species, and tests in which the larvae were kept in sand treated with solutions of potassium chloride indicated that this was due to the greater permeability of the cuticle.

It is concluded that the effect of BHC on soil-inhabiting larvae depends not only on the intensity of metabolism, but also, and to an equal extent, on the permeability of the integument.

[Peredel'skiĭ (A. A.), Bocharova (O. M.) & Starovoĭtova (M. K.).] Передельский (А. А.), Бочарова (О. М.) и Старовойтова (М. К.). **Characteristics of the Migration of the Noxious Little Tortoise (*Eurygaster integriceps* Put.) from its Hibernation Sites in the Mountains in the Department of Krasnodar.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **77** no. 3 pp. 499–502, 3 refs. Moscow, 1951.

Eurygaster integriceps Put. is a serious pest of cereals in the region of Krasnodar, North Caucasus. It overwinters mainly in the forested foothills to the north of the Caucasus mountains and also to some extent in wooded areas in the plain, and migrates to the fields in spring, as in other parts of the Soviet Union [*cf. R.A.E.*, A **40** 309–310, etc.]. It was formerly thought that the migrating bugs flew directly to the grain fields north of the Kuban, but the occurrence of damage to the south of the river in 1948 and 1949 rendered this doubtful. Observations were therefore made in April and May 1950. Owing to an unusually early spring, the bugs hibernating in the plain resumed activity early and moved to grain fields south of the river in the first two weeks of April, infestation occurring in patches that were frequently widely separated. Mass flight from the mountains took place between 16th and 18th April, when daily temperatures in the plain averaged 16·5°C. [61·7°F.] with maxima of 23–26°C. [73·4–78·8°F.]. The bugs alighted on the left bank of the river in fields situated about 3–12 miles from the foot of the mountains, where considerable numbers of them settled and oviposited. Others remained only for a short time and then flew across the river, infestation to the north becoming considerable in early May. It is thought that control measures applied in the fields to the south might protect those to the north of the river from infestation.

Heinze (K.). **Die Schädlinge, Krankheiten und Schädigungen unserer Hackfrüchte (Kartoffeln und Rüben).** [The Pests, Diseases and other Causes of Injury of our Root Crops (Potatoes and Beet).]—9½ × 6¾ ins., xvi + 367 pp., 189 figs., many refs. Berlin, Duncker & Humblot, 1953. Price *DM.* 44.

Of the 11 main sections of this book, the first (pp. 1–154) is devoted to insects, other arthropods and miscellaneous animal pests that damage potato and beet in Germany, arranged according to whether they attack one or both crops and are injurious in the soil or above it. The information on the individual species includes descriptions of the various stages, summaries of bionomics, notes on the type of injury caused, and recommendations for control, with records of natural enemies in some cases. Vectors of viruses of potato or beet are included in this section, but their importance as vectors is more fully discussed in later sections dealing with the virus diseases of the two crops.

Evenhuis (H. H.). **Bepaling van de tijdstippen waarop tegen het fruitmotje, *Enarmonia (Carpocapsa) pomonella* L., gespoten moet worden.** [Determination of the Dates of Spraying against the Codling Moth.] —*Tijdschr. PlZiekt.* **59** pt. 1 pp. 9–22, 7 figs., 7 refs. Wageningen, 1953. (With a Summary in English.)

The methods used in Holland for determining the dates on which apple trees should be sprayed against first-generation larvae of *Cydia (Enarmonia) pomonella* (L.) are briefly described. The best results are usually obtained from records of adult emergence in special emergence boxes. These contain corrugated-cardboard bands taken from the trunks of heavily infested trees after the larvae have entered them in search of hibernation sites, are screened from direct sunlight and rain and are closed to the light before emergence is expected to begin, being fitted with a test-tube into which emerging moths are attracted. The results given by this method are not completely accurate, however; in 1951, the first moths emerged on 30th May in gauze cages placed over trap bands on the trees in one orchard in Zeeland and adults were seen on the wing in another on 1st June, whereas emergence only began in the boxes on 10th June. That emergence is affected by direct sunlight was shown in an experiment in which cocoons were placed in four gauze cages facing north, south, east and west, respectively, on a pole 4 ft. 6 ins. high, the moths emerging considerably earlier than in a control cage shaded from direct sunlight or than in the screened boxes [*cf. R.A.E.*, A **17** 89]. The emergence data obtained are shown on a graph. Observations confirmed earlier findings that 15°C. [59°F.] was the minimum temperature at which the moths were active.

In a test on control, apple trees were sprayed twice, on 16th June and 12th July, or once, on 29th June or 12th July, with a wettable-powder spray containing 0·015 per cent. parathion. The percentages of apples infested averaged 2·8, 8·6 and 7·3 for the three treatments, respectively, as compared with 24·2 in the controls. The optimum date for spraying is connected directly, not with that of adult emergence, but with that on which the larvae hatch. This date was ascertained by releasing fixed numbers of young adults of both sexes in a cage erected round a tree and making frequent searches for eggs and larvae. The first eggs were laid after 1–3 days, and the period between the peaks of oviposition and hatching was 13–15 days in June and 9–11 days in July.

The results of the spray tests are analysed in the light of these findings. Treatment on 12th July reduced infestation by 70 per cent. If the egg stage lasted 13 days and the larvae required another three days to reach the cores of the fruits, after which parathion sprays are ineffective against them, not more than 30 per cent. of the adults could have emerged before 26th June. It appeared from the emergence data that 30 per cent. emergence was reached in the four cages facing south, west, east and north, in the control cage and in the emergence boxes on 30th and 31st May, 2nd and 16th June, and 1st and 5th July, respectively, so that only the results given by the control cage or the emergence boxes were in agreement with the results of the spray tests. Not less than two and a half weeks were required for 70 per cent. emergence from the boxes, and it is considered that the parathion remained effective for at least this period and probably longer.

It is concluded that emergence begins earlier in the orchard than in the boxes, but that the dates of maximum emergence are about the same in both. This may be because tree trunks that are exposed to direct sunlight early in spring are shaded by the foliage later in the season. To determine the date of the first spray, the results obtained from the emergence boxes should be supplemented by direct observation of moth flight in the orchard

on evenings when the temperature exceeds 15°C., beginning in mid-May, and possibly also of oviposition. The second application, which is the most important, should be made after the main peak of emergence in the boxes and preferably not later than three weeks after the first if parathion is used. If emergence is very protracted, a third application should be made after a further three weeks.

Geier (P.). **Note préliminaire sur l'hivernage de *Quadraspidiotus perniciosus* Comst. (Hémipt. Diaspidoïde).**—*Mitt. schweiz. ent. Ges.* **23** pt. 3 pp. 329–336, 4 graphs, 5 refs. Berne, 1950.

Observations on apple near Lausanne in 1949–50 showed that the only examples of *Quadraspidiotus perniciosus* (Comst.) to survive the winter are the first-stage nymphs that have undergone a summer diapause. They belong mainly to the second generation of the year, but may include some individuals of the first or a partial third generation. Most of them emerge from diapause in October, and all reach the state immediately preceding the first moult by about January. Moulting does not occur, however, until temperatures exceed 10°C. [50°F.] for a considerable period. Although the overwintered nymphs are of widely varying ages, they all moult within a period of about a fortnight in March–April.

Ruiz Castro (A.). **Fauna entomológica del olivo en España. Estudio sistemático-biológico de las especies de mayor importancia económica.** [The Insect Fauna of Olive in Spain. A Study of the Classification and Biology of the Species of greatest economic Importance.] **I (Generalidades, Coleoptera y Diptera).**—182 pp., 9 pls. (2 col., 2 fldg.), 96 figs., 4 pp. refs. Madrid, Inst. esp. Ent., 1948. **II (Hemiptera, Lepidoptera y Thysanoptera).**—166 pp., 79 figs., 2½ pp. refs. 1951.

In the first section of this work, accounts are given of the history of the cultivation of olives in Spain, the characteristics of the regions in which they are grown, the varieties cultivated, and their distribution, together with maps showing the areas involved and the annual value of the crop in each region. The second section comprises a systematic list of the insects found on olive in Spain and a few that are found on other plants there but are known to attack olive in other countries. Detailed locality records are given in many cases, and local popular names are shown. The third section, which occupies most of the first volume and the whole of the second, contains information on the morphology, synonymy, distribution, bionomics, economic importance and natural enemies of the seven most serious pests. These are *Phloeotribus scarabaeoides* (Bern.), *Dacus oleae* (Gmel.), *Saissetia* (*Coccus*) *oleae* (Bern.), *Euphyllura olivina* (Costa), *Hysteropterum grylloides* (F.), *Prays oleellus* (F.), and *Liothrips oleae* (Costa).

Papers noticed by Title only

Melis (A.). **Elenco delle principali specie animali che hanno prodotto infestazioni degne di nota in Italia durante l'anno 1950.** [A List of the principal Species of Animals that caused Infestation worthy of Notice in Italy in the Year 1950.]—*Redia* **36** (1951) pp. iii–xviii, 1 ref. Florence [1952]. [*Cf. R.A.E.*, A **36** 141; **41** 128, etc.]

Woolley (T. A.). **Some Acarological Techniques** [mainly for preparing specimens of mites].—*J. econ. Ent.* **46** no. 2 p. 366, 1 ref. Menasha, Wis., 1953.

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Printed in Great Britain under the authority of HER MAJESTY'S STATIONERY OFFICE
by The Eastern Press, Ltd., Reading.
(1426) Wt. P3/3884 12/53 E.P. Ltd. Gp. 566 [A]